UNITED STATES ARMY AVIATION DIGEST

JANUARY 1962

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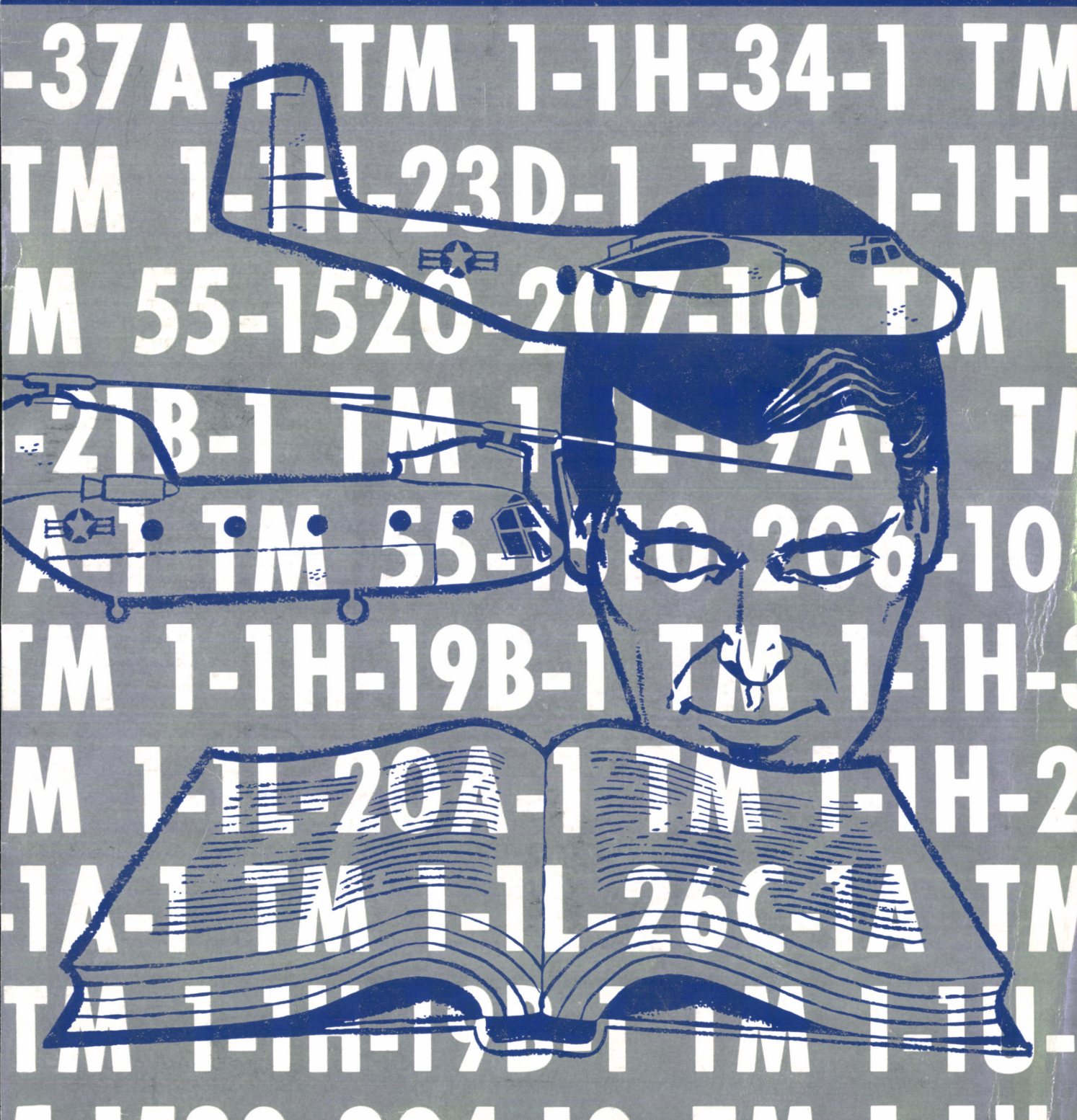

United States Army

AVIATION DIGEST

JANUARY 1962 VOLUME 8 NUMBER 1

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HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR MILITARY OPERATIONS
WASHINGTON 25, D. C.

AV EX 30 November 1961

SUBJECT: Award of Senior Aviator Badge

TO: Army Aviation Digest
U. S. Army Aviation School
Fort Rucker, Alabama

1. It is always a pleasure to recognize outstanding achievement for distinguished service. It is a particular pleasure to note the presence of a well deserved star to the badge proudly displayed on the masthead of the Army Aviation Digest.

2. In my office I have the bound volumes of the earliest issues of this magazine, and by scanning of few of these pages one can quickly appreciate how far this journal has advanced in stature since its inception. I believe the mature and professional status of the current Digest aptly reflects the entire Army aviation program.

3. While recognizing the award of the Senior Army Aviator Badge to the Digest, I would like to add my congratulations to those responsible for its continued growth. To its editorial staff, the supervisors and contributors-- well done! I am convinced that I speak for all Army aviators when I wish continued success toward the day when a wreath will surround the star on the cover.

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Director of Army Aviation, ODCSOPS

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The U. S. ARMY AVIATION DIGEST is an official publication of the Department of the Army published monthly under the supervision of the Commandant, U. S. Army Aviation School.

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine and other related data.

Manuscripts, photographs, and other illustrations pertaining to the above subjects of interest to personnel concerned with Army Aviation are invited. Direct communication is authorized to: Editor-in-Chief U. S. ARMY AVIATION DIGEST, U. S. Army Aviation School, Fort Rucker, Alabama.

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Aircraft Handbooks

REMEMBER THAT close call you had — the time you nearly cracked up your aircraft? You were lucky. You got away with it, and maybe no one but you will ever know about it.

And perhaps no one will ever know how your stomach tied itself up in knots after it was all over.

What happened? Was it a takeoff that didn't pan out just right? Maybe that "rough figure" for an average load didn't add up with the density altitude that day. How did it feel dragging your landing gear through the treetops?

Your near-accident may have been different, but who, or what, did you blame for it? Could it have been that **you didn't know enough about the aircraft you were flying?** The chances are that you're not as familiar with your -10 (pilot's handbook) as you should be. USABAAR accident reports and a check of individuals and units indicate that many Army Aviators (and sometimes the line and crew chiefs) fail to read the handbooks and keep up with the changes. USABAAR statistics also show that many accidents are attributed to this cause.

Yes, you're probably one that has a valid excuse. You don't have a handbook readily available—one that you can keep and browse through at your convenience. You have to go to the line shack, the maintenance office or to headquarters to get one. Then you can only have it a few minutes and probably have to read it on the spot. Or perhaps you have managed to get a personal copy of a handbook, but haven't kept up with the changes.

This may be the situation in your unit, **but actually every Army Aviator is entitled by regulations to have his own handbook for each aircraft he is qualified to fly.** (DA Circular 310-52, dated 12 Jul 61, and DA Form 12-5, dated 1 Feb 61.)

When each aviator has a handbook and can study and thoroughly understand the information it contains, he will be making a major contribution to aircraft accident prevention.

Most Army Aviators want personal handbooks but are confronted with these problem areas:

- How do they obtain the handbooks?
- How do they keep them up-to-date?

PROCURING HANDBOOKS

The handbooks, along with other Army Aviation literature, can be obtained in accordance with instructions contained in Department of the Army Circular 310-52, dated 12 Jul 61, and DA Form 12-5, dated 1 Feb 61.

These regulations are intended to make handbooks and other aviation literature pertinent to execution of the organizations' missions available in sufficient quantity to provide one copy to each assigned Army Aviator. This is in addition to normal operating and library requirements, which should already be on hand in sufficient quantity to meet maintenance needs.

It is the responsibility of individual unit commanders to procure adequate copies for maintenance and library requirements and to provide each aviator a personal handbook for each aircraft the individual is qualified to fly.

When a new aviator reports to a unit, that organization **will** issue him handbooks on the aircraft he flies. If the unit does not have a particular handbook, the commander will obtain one in accordance with the regulations mentioned above. When an aviator is transferred, he will turn in all of his individual handbooks to the losing unit.

KEEPING HANDBOOKS CURRENT

It is also the unit commander's responsibility to ensure that his aviators receive all changes to the handbooks. He will do this in accordance with instructions contained in the regulations mentioned above.

Individual pilots are responsible for posting changes to their handbooks.

Aviators being transferred will turn in current handbooks to the losing unit and will be issued current handbooks at the gaining unit.

Getting handbooks for individuals will not itself reduce the aircraft accident rate. The handbooks must be kept up-to-date and studied at regular intervals. Getting aviators to do this is a difficult task.

One of our sister services, which makes handbooks available to all of its aviators, found that a considerable number of accidents were caused by aviators not knowing basic information contained in their handbooks. A private research organization studied this matter for this service and came up with the following facts:

- Almost one-fourth of the pilots do not even have a flight manual for the aircraft they are flying.

- Of those who do have one, 42 percent are either not sure it is up-to-date or are definitely sure it is not up-to-date.
- In one case, there was only one current flight manual in an entire unit.
- Student aviators seldom use the flight manual for any purpose.
- Most aviators do not understand the revision system for flight manuals.
- Aviators interviewed did not know the meaning of CAUTION or WARNING notes used in the flight manual.
- No standard method of distributing flight manuals or revisions within the individual units is used.

Do any or all of these facts apply to you or your Army Aviation unit?

Unfortunately, on checking individuals and units, it was discovered that the same troubles beset Army Aviation. Based on our sister service's experience, we can expect to be plagued by these problems even though handbooks are available to all aviators.

What's the answer? It's a personal thing. No one is going to make you sit down and review your handbook periodically. But unless Army Aviators do this, there will continue to be numerous accidents such as those reviewed in this month's "Crash Sense."

Turn to "Crash Sense" and read about these accidents. As you do, bear in mind that you may only have had a close call. Next time it could be closer, and then it will be **your** accident reviewed in "Crash Sense."

Face it: it's up to you to know your handbook inside out. Whether or not you think you do, take the following quizzes on the aircraft you fly and see where you stand.

H-13

Reference: TM 55-1520-204-10, September 1960 Operators Manuals H-13E, H-13G, H-13H

1. At what minimum airspeed (mph) may power be used and still maintain directional control after an anti-torque failure in flight?
   a. 10
   b. 20
   c. 30
   d. Over 40

1. d. Page 46

2. Under normal wind conditions the best indicated airspeed for maximum glide distance in autorotation is
   a. 30 mph.
   b. 40 mph.
   c. 50 mph.
   d. 65 mph.

2. d. Page 42

3. The power-off minimum rate of descent is obtained by maintaining a forward speed of approximately
   a. 45 mph.
   b. 60 mph.
   c. 35 mph.
   d. 70 mph.

3. a. Page 42

4. What is the overall length of the H-13 helicopter with the main rotor blade paralleling the fuselage?
   a. 35 feet 1.5 inches.
   b. 38 feet 4.50 inches.
   c. 41 feet 4.75 inches.
   d. 45 feet 4.75 inches.

4. c. Page 6

5. What is the diameter of the main rotor disc?
   a. 33 feet 2 inches.
   b. 35 feet 1.5 inches
   c. 38 feet 1.5 inches.
   d. 41 feet 4.75 inches.

5. b. Page 6

H-19

References: TM 1-1H-19B-1, March 1959.

1. The basic operating weight of the H-19 helicopter is
   a. 5,650 pounds.
   b. 6,300 pounds
   c. 6,350 pounds.
   d. 7,100 pounds.

1. a. Page 5-7

2. After starting, and with the transmission oil pressure gauge indicating within normal limits, the transmission pressure warning light will remain on until
   a. normal transmission operating temperature is reached.
   b. normal engine operating pressure is reached.
   c. transmission oil pressure shows increase.
   d. generator power output is normal.

2. a. Page 1-18

3. Fuel lowlevel warning lights will not operate if
   a. quantity gauges are inoperative.
   b. pressure guages are inoperative.
   c. AC power failure exists.
   d. DC power failure exists.

3. d. Page 1-22

4. While starting the engine, a hydraulic lock is discovered. What should be done to eliminate it?
   a. Continue with starting procedure.
   b. Remove spark plug from lower cylinders.

c. Drain the oil tank.
d. Pre-oil the engine.

4. b. Page 7-1

5. If retreating blade stall is encountered in flight the aviator should

a. increase airspeed and rotor rpm.
b. reduce airspeed and rotor rpm.
c. reduce airspeed and increase rpm.
d. reduce airspeed and increase collective pitch.

5. c. Page 6-1

H-21

Reference: TM 1-1H-21B-1, July 1957

1. Engine operation above 2500 rpm is limited to how many minutes?

a. 5
b. 10
c. 20
d. 30

1. d. Page 5-6

2. What is the minimum engine overspeed requiring write-up?

a. 2700 rpm
b. 2750 rpm
c. 2780 rpm
d. 3000 rpm

2. c. Page 5-1

3. If the engine is misfiring or causing an uneven power supply to the rotor system, the pilot should

a. autorotate to the nearest possible landing area to avoid damage to the rotor drive system.
b. continue with partial power to the nearest suitable landing area.
c. be prepared for complete engine failure.
d. try to determine the cause of the difficulty and take corrective action.

3. a. Page 3-1

4. Which of the following engine rpm and manifold pressure settings constitute an overboost?

a. 2300 rpm, 38″ Hg
b. 2400 rpm, 42.5″ Hg
c. 2500 rpm, 46.5″ Hg
d. 2700 rpm, 51.5″ Hg

4. b. Page 5-6

5. The operating weight of the H-21C including crew is

a. 8,500 pounds.
b. 9,000 pounds.
c. 9,500 pounds.
d. 11,500 pounds.

5. c. Page 5-9

H-34

Reference: TM 1-1H-34-1, January 1960.

1. In the event of servo failure in flight, the pilot should

a. turn off all switches and land immediately.
b. go immediately into autorotation.
c. increase airspeed to 80 knots and continue flight.
d. turn malfunctioning servo off and land.

1. d. Page 3-17

2. Should ground resonance occur at high rpm, the safest means of recovery is to

a. apply pitch and power and become airborne.
b. disengage servo unit to dampen oscillation.
c. decrease pitch while increasing rpm.
d. neutralize cyclic and pedal controls.

2. a. Page 6-7

3. When, if ever, may the fuel boost pump be turned off in flight?

a. Between 2,000 and 8,000 feet MSL.
b. When flying above 10,000 feet MSL.
c. When engine driven fuel pump fails.
d. Never.

3. a. Page 1-22

4. Rotor engagement should **not** be performed until the engine oil temperature reaches

a. 100°C or rises 10° above prestart temperature.
b. 30°C or rises 10° above prestart temperature.
c. 40°C or rises 6° above prestart temperature
d. 20°C or rises 3° above prestart temperature.

4. c. Page 2-6

5. Which of the following would give a false indication if both inverters failed?

a. Transmission oil temperature.
b. Fire detection system.
c. Engine oil temperature gauge.
d. Fuel pressure gauge.

5. d. Page 3-17

H-37A

Reference: TM 1-1H-37A-1, July 1959

1. How many litters is the H-37A designed to transport?

a. 16
b. 24
c. 28
d. 30

1. b. Page 1-1

2. Maximum allowed rearward hover speed of the H-37A is
   a. 10 knots.
   b. 12 knots.
   c. 15 knots.
   d. 20 knots.

2. d. Page 5-8

3. Most rapid movement of collective pitch allowed (from low to high) is
   a. 2 seconds.
   b. 4 seconds.
   c. 6 seconds.
   d. 10 seconds.

3. a. Page 5-5

4. An immediate landing should be made if the temperature of the main gear box exceeds
   a. 140°C.
   b. 160°C.
   c. 180°C.
   d. 200°C.

4. a. Page 5-4

HU-1A

Reference: Part I, Operators and Crew Members Instructions, Army Model HU 1A Helicopter (Bell), TM 55-1520-207-10, 15 March 1960

1. The T53-L-1 gas turbine powerplant in the HU-1A is derated to a maximum output torque equivalent of
   a. 770 hp at 6400 rpm.
   b. 770 hp at 5800 rpm.
   c. 700 hp at 6400 rpm.
   d. 700 hp at 6100 rpm.

1. a. Page 1-3

2. The normal operating range of the main rotor is
   a. 285 to 314 rpm.
   b. 285 to 330 rpm.
   c. 314 to 330 rpm.
   d. 580 to 620 rpm.

2. a. Page 6-3

3. The maximum permissible indicated forward airspeed of the HU-1A is
   a. 95 kt.
   b. 100 kt.
   c. 105 kt.
   d. 115 kt.

3. c. Page 6-1

4. Maximum permissible rotor rpm during autorotation is
   a. 285 rpm.
   b. 314 rpm.
   c. 330 rpm.
   d. 646 rpm.

4. c. Page 6-1

L-19A & E

Reference: TM 55-1510-202-10, April 1961

1. While in a glide without flaps, what indicated airspeed in mph will normally result in covering the greatest distance?
   a. 68
   b. 72
   c. 75
   d. 80

1. c. Page 3-2, figure 3-1

2. What is the maximum permissible indicated airspeed in mph with the observer's windows open?
   a. 135
   b. 145
   c. 155
   d. 160

2. b. Page 5-1

3. What is the recommended airspeed in mph for flight in turbulent air?
   a. 80
   b. 90
   c. 100
   d. 110

3. c. Page 9-4

4. What is the stalling speed (mph IAS) in level flight with 0° flaps at 2,100 pounds gross weight?
   a. 47
   b. 54
   c. 59
   d. 64

4. b. Page 6-2, figure 6-1

5. What is the maximum rpm propeller speed?
   a. 2600
   b. 3000
   c. 3400
   d. 3600

5. a. Page 5-1

L-20

Reference: TM 1-1L-20A-1, January 1960

1. The maximum allowable fuel pressure is
   a. 2 psi.
   b. 4 psi.
   c. 6 psi.
   d. 8 psi.

1. d. Page 5-2, figure 1

2. Crosswind takeoffs and landings are not recommended when the lateral component of the wind velocity is more than
   a. 10 kt.
   b. 13 kt.
   c. 15 kt.
   d. 22 kt.

2. a. Page 2-12

3. Recommended indicated airspeed for normal approach is
   a. 75 mph.
   b. 80 mph.
   c. 85 mph.
   d. 90 mph.

3. b. Page 2-12

4. If the engine does not start due to overpriming, what is the correct procedure for clearing excess fuel from the induction system?

a. With ignition switch off and throttle open, turn propeller forward four or five blades.

b. With ignition switch off and throttle open, turn propeller backward four or five blades.

c. With ignition switch off, throttle closed, and mixture idle cut off, turn propeller through eight or ten blades with the starter.

d. With ignition switch off, throttle open, and mixture idle in cutoff position, turn propeller through eight to ten blades with the starter.

4. d. Page 2-5

5. Operation at more than METO power but not to exceed maximum allowable rpm should be limited to

a. 1 minute.
b. 3 minutes.
c. 5 minutes.
d. 7 minutes.

5. a. Page 5-2, figure 1

U-1A

Reference: TM 1-1U-1A-1, January 1960

1. What is the METO power setting?

a. 34.5 Hg, 2200 rpm.
b. 33 Hg, 2200 rpm.
c. 33.5 Hg, 2150 rpm.
d. 33.5 Hg, 2200 rpm.

1. d. Page 5-3, figure 5-1

2. What is the stalling speed in knots IAS (no flaps, maximum gross weight, 0° bank)?

a. 45
b. 49
c. 58
d. 65

2. c. Page 6-2, figure 6-1

3. What is the maximum allowable airspeed for flaps use?

a. 75 kt
b. 83 kt
c. 88 kt
d. 90 kt

3. b. Page 5-4

4. What is the cautionary speed range for land plane operations (knots IAS)?

a. 100-148
b. 125-168
c. 135-186
d. 150-168

4. b. Page 5-2, figure 5-1

5. Approximately how many gallons of fuel remain in the selected tank when the low fuel level warning light comes on during level flight?

a. 7
b. 9
c. 11
d. 15

5. a. Page 1-9

L-23D

Reference: TM 1-1L-23D-1, April 1969 (change 3, Sep 1960)

1. The maximum takeoff power limit indicated on the manifold pressure instrument face is applicable for what altitude?

a. All altitudes.

b. Sea level to 5,000 feet pressure altitude.

c. Sea level barometric pressure only.

d. Sea level to 1,000 feet pressure altitude.

1. c. Page 2-20

2. What is the minimum single engine control speed (IAS) with full rudder and trim, 0° flaps, and propeller windmilling?

a. 91 kt
b. 81 kt
c. 79 kt
d. 75 kt

2. a. Page 3-2, figure 3-2

3. What is the recommended procedure for instrument inverter management?

a. Normal operation on main.

b. Alternate operation on main and standby every 2 hours of flight.

c. Alternate operation only during periods of high load.

d. Operate on main and standby an equal amount of time.

3. d. Page 1-16c

4. If the nose baggage compartment door is open, the engines cannot be started because

a. the starter circuit only is open.

b. the primer circuit only is open.

c. both the starter and primer circuits are open.

d. all electrical circuits are open.

4. c. Page 1-9

5. A full feathering check should not be attempted when the engine is turning in excess of

a. 1000 rpm with sea level barometric pressure.

b. 1500 rpm with sea level barometric pressure.

c. 1500 rpm with any barometric pressure.

d. 2600 rpm with sea level barometric pressure.

5. b. Page 2-8

THE COMMANDER

and Preventive Maintenance

Lieutenant Victor A. Weber, Inf

THE RESPONSIBILITY for preventive maintenance falls upon the man who is responsible for every other activity of his unit—the commander. When we consider the number of Army Aviators in command positions, we see that very few do not command at some echelon. Preventive maintenance responsibility then, is ours.

What does this responsibility include? We will start with a definition of preventive maintenance: It is to stop failures before they start, or to keep our equipment in the best possible condition at the using level by oiling, cleaning, servicing, part replacement, and inspection.

We must comply with instructions and procedures for preventive maintenance operations, the training of our subordinates in preventive maintenance of equipment, and allocation of sufficient time for the performance of preventive maintenance. To determine whether our preventive maintenance program is doing its job, we must have a quick and adequate means of inspection. The best system at our disposal is the use of PM indicators.

PM indicators are selected inspection points which will give us a general, but not positive, idea of the status of equipment. It is a sampling technique meant primarily for the commander. The use of indicators is definitely not a replacement for thorough inspections by maintenance personnel and operators.

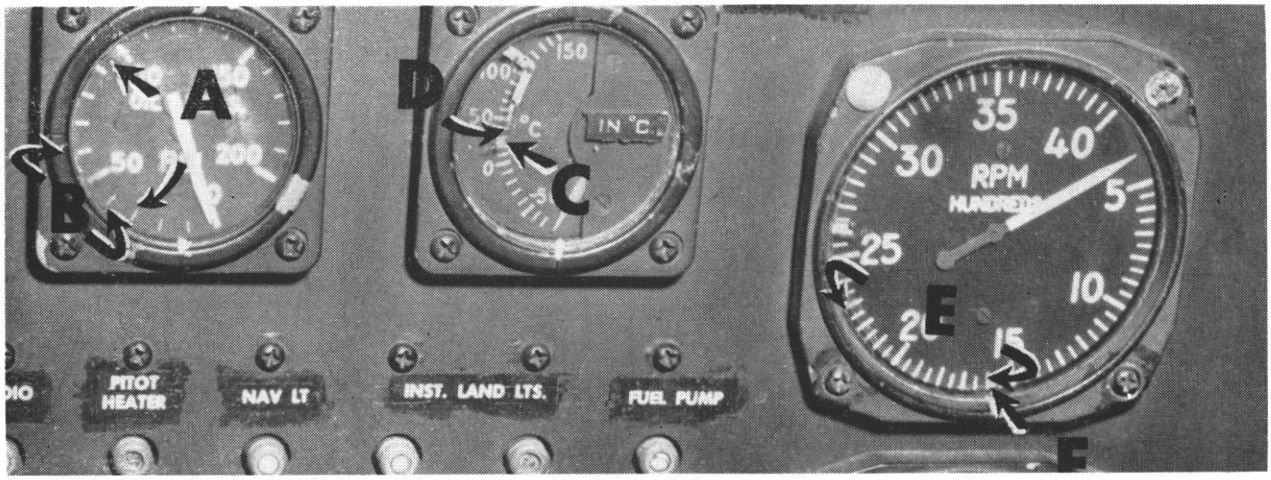
There are several good reasons for a commander's use of PM indicators. First, he should inspect. The commander tends to consider that the responsibility for inspection of equipment belongs to the specialist, and is beyond his capability. We cannot rely on someone else when the responsibility is ours. Personal inspection by the commander is the most important element of effective unit maintenance. This includes commanders at all levels, whether it be at aviation company level or the section leader in a platoon.

Also, the commander is not a specialist; therefore, his inspection must be limited in scope. Considering the complexity of our aircraft and related equipment and the many other aspects of the commander's job, it would be impractical to expect him to know technical details or to inspect them. PM indicators provide him with a compromise to this problem.

Finally, there is the time element. Even if the commander were a technician, he would not normally have the time available for a thorough inspection of equipment. Again, the use of indicators provides a solution through sample readily accessible inspection points.

The commander is not expected to use PM indicators without prior knowledge or instructions. He should get an orientation from his technical personnel, using the indicator as a guide. Department of the Army Pamphlet 750-1 with

Lt Weber is assigned to the Special Subjects Branch, Dept of Maintenance, USAAVNS. He is fixed wing rated.



Oil Pressure gauge. Both red lines (max and min) are missing, A. They should be at 30 psi minimum and 95 psi maximum. The green line which should extend from 40 to 60 psi is missing, B. Oil Temp gauge. The oil temperature minimum red line of 24°C is missing. It should appear at point C. The green area which should extend from 38°C to 108°C is partly obliterated, D. Tachometer. No green line shows on the rpm indicator. It should extend from 1600 to 2300 as indicated, E. The slippage mark is obliterated, F.

changes 1 and 2 lists PM indicators for various types of equipment, to include several helicopters and the L-19 and L-20 fixed wing aircraft. By using this list as a guide, one can inspect virtually any aircraft in the inventory. It is important for the commander to know exactly what he is looking for. It is better to inspect a few points thoroughly and with confidence, than to make a hasty inspection of several.

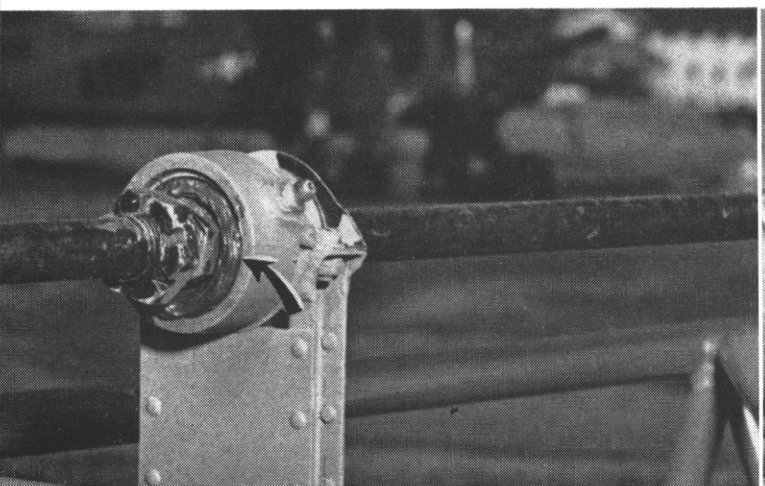
A detailed inspection of each piece of equipment is unnecessary. You may inspect several pieces of equipment thoroughly, or inspect a much larger sampling of your equipment, but only check two or three indicators on each item. Either of the two techniques will give you a good idea of the status of maintenance on all of the equipment.

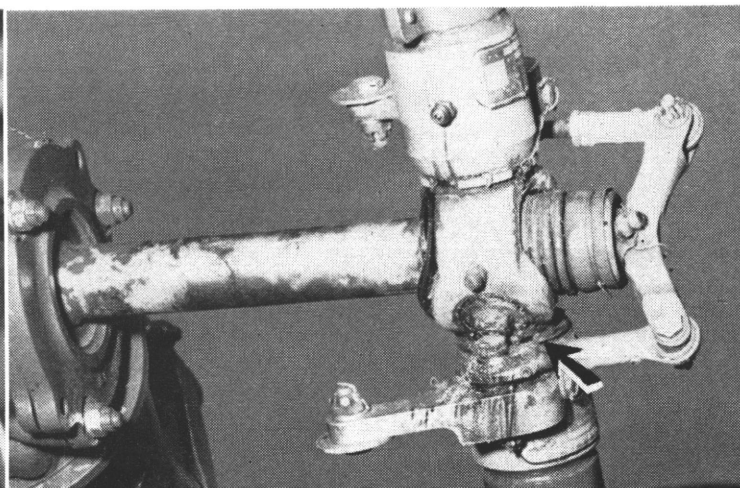
Avoid letting your inspections become stereotyped. As you become more familiar with the equipment, expand the list of inspection points for each item and use different indicators for each inspection.

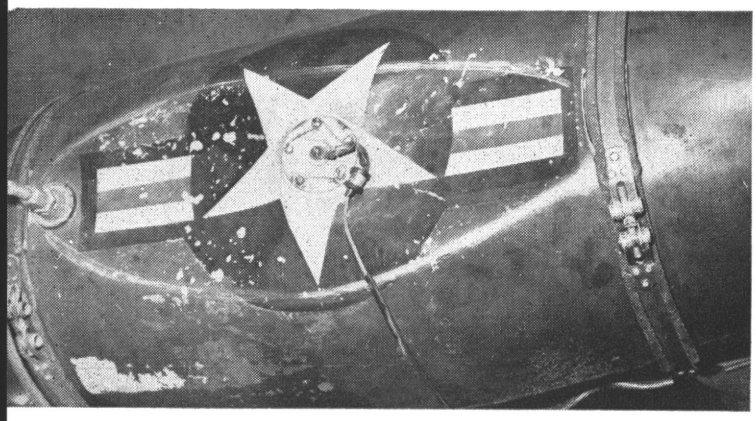
One of the simplest, and often overlooked, indicators is the ability of the equipment to operate and function properly. Many items of equipment have passed a superficial inspection just because the inspector failed to have the operator start it, or put it into operation. If it will operate, it is unlikely that there is any major deficiency at the moment. This also provides an indication of the proficiency of the operator.

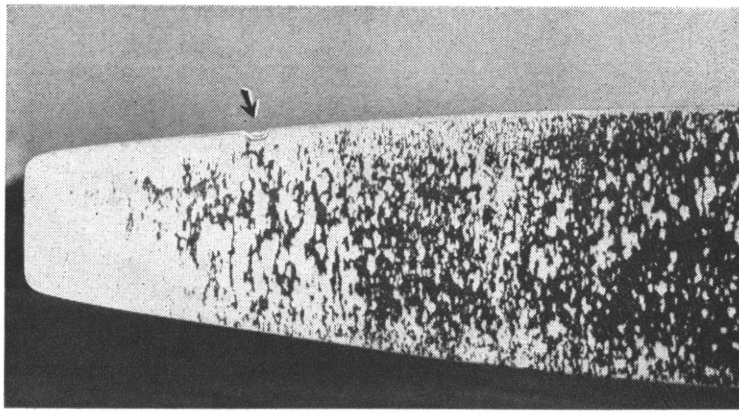
Cleanliness of equipment, proper marking, and absence of rust and dents are a part of maintenance as well as an indication of morale and disci-

Left: Arrow points to excessive grease which has collected dirt on the H-13 tail rotor pitch change link. Right: Arrow points to excessive grease on the tail rotor drive shaft hanger bearings of an H-13. This has blown a seal and results in insufficient grease in the bearing. Also, grease which spills out catches dirt. These are flight safety hazards.









Left: Someone uses top of H-13 fuel tank for stepping stone. Right: Arrow points to bad nick on L-19 prop. The nick has not been properly rounded out. This prop blade also shows a lot of chipped paint and other minor dents. It has been taxied and run up on gravel and dirt. This not only damages your own aircraft, but also other aircraft or even personnel in the vicinity. Never run up engine on dirt or gravel.

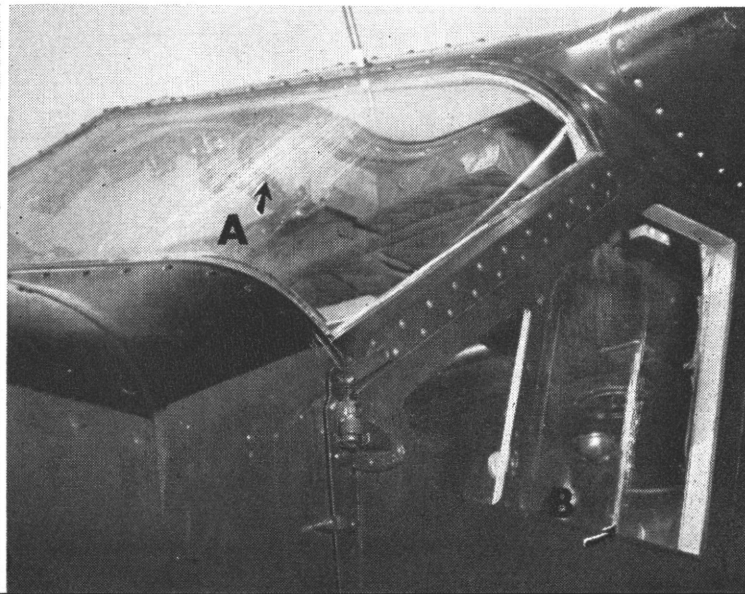
pline. However, we should beware of an overemphasis on what we term "eyewash." It is very easy to conduct a superficial inspection simply because we do not know the item of equipment. An inspection based purely on appearance will not suffice when inspecting aviation equipment. Furthermore, we don't want our maintenance personnel spending all of their time cleaning and marking equipment.

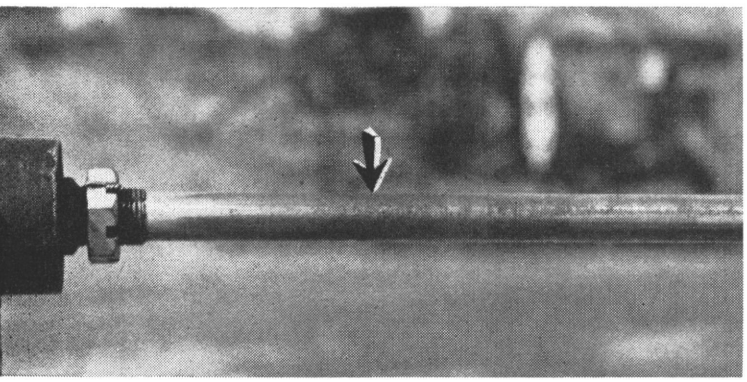
We should expect standards of cleanliness and painting of equipment in accordance with the mission of the unit and time available. Examples of conditions which we do not want to find are: clogged lubricating points, rust or dirt in bearings; dirt which affects safe operation, such as on windows or windshields; dirt on meters or dials, which will prevent proper readings by the operator; and grease or oil on rubber surfaces.

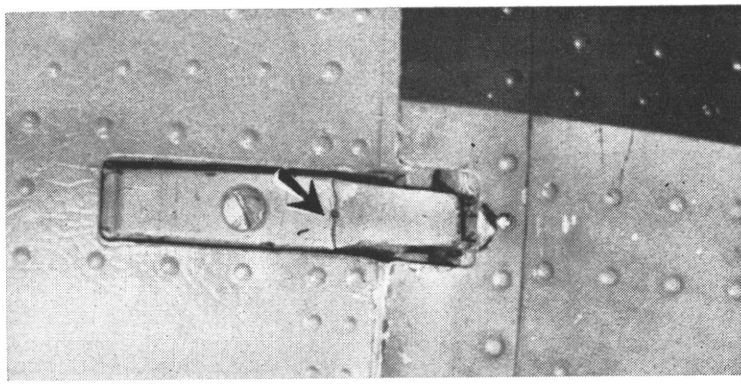
Besides inspecting the equipment itself, some time should be spent inspecting administrative and operational aspects of the maintenance system. These include supply, storage, technical literature, and shop operations. The commander cannot hope to make a thorough inspection of these areas. Here also, he will have to use selected inspection points.

Availability of repair parts is a probable indication of the status of maintenance and the efficiency of the unit. The commander cannot know the unit's authorized stockage level or the nomenclature of a specific part Before each inspection he can make a point of knowing the nomenclature of a specific part or parts and the authorized stockage level. He should also be familiar with the unit's req-

Left: The copilot's window on this L-20 is badly scratched, resulting in poor visibility. Right: A dirty windshield on an L-20 (A) and a badly scratched pilot's window at B. This reduces visibility and increases the hazard to flight safety.







Left: Corrosion on H-13 Tail rotor drive shaft. Right: Arrow points to a crack that has been stop drilled on the cowling fastener of an L-20. This often stops a crack from spreading until more permanent repairs can be made. In this case it did not stop the crack. Inspection should have caught this.

uisitioning procedure. If he discovers that a part is not available at the authorized level he can determine whether or not it was requisitioned. He can then trace the part back through the maintenance supply system. He can also examine the unit deadline report and determine if certain pieces of equipment have been deadlined for excessive periods of time.

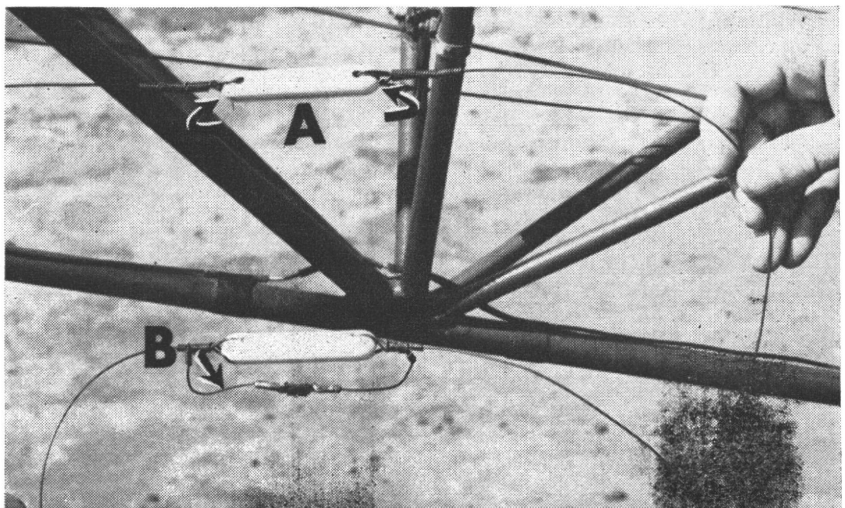
The publications authorized in the unit are another important indicator to be inspected. The commander can pick a specific authorized publication and check for its availability. He might also check to see that no unauthorized publications are on hand. While looking at publications it is a good idea to determine the extent of their use. A complete up-to-date set of publications is a fine thing to have. However, if they aren't used, they are of no benefit. Check particularly those manuals used in the maintenance of equipment. If they are clean and neat, it is a good indication that mechanics are not using them, as they should, in performing maintenance.

The mechanic's and unit's tools should also be inspected. Learn the nomenclature and use of one or several tools and inspect for availability and condition. Also check for unauthorized tools. The use of improper tools can cause damage to the equipment being worked on, as well as to the incorrect tool being used. A higher echelon of maintenance can be hampered by the lack of a tool which is in the hands of an unauthorized lower echelon.

A close look at maintenance operations will reveal many signs of potentially good or bad maintenance. The ability of individual mechanics to perform various checks or repairs is an excellent indicator of maintenance status and training. Select an operation and learn how it should be performed and how long its performance should take. Then select a mechanic at random and have him perform the operation. This procedure will give you an opportunity to check tools, their proper use, the knowledge of the mechanic, and the supply system, if repair parts are necessary.

Through the use of these guidelines and the PM indicator guides published in Department of the Army Pamphlet 750-1, the commander can keep abreast of the maintenance capability of his unit. Inspections may be performed any time that the commander has a free hour or two. When our maintenance personnel are properly supervised and inspected they will produce the desired availability rate.

H-13 low frequency antenna. The jumper wire is missing at the insulator, A. The missing wire greatly reduces the efficiency of the antenna. B shows proper installation.



PREVENTIVE MAINTENANCE

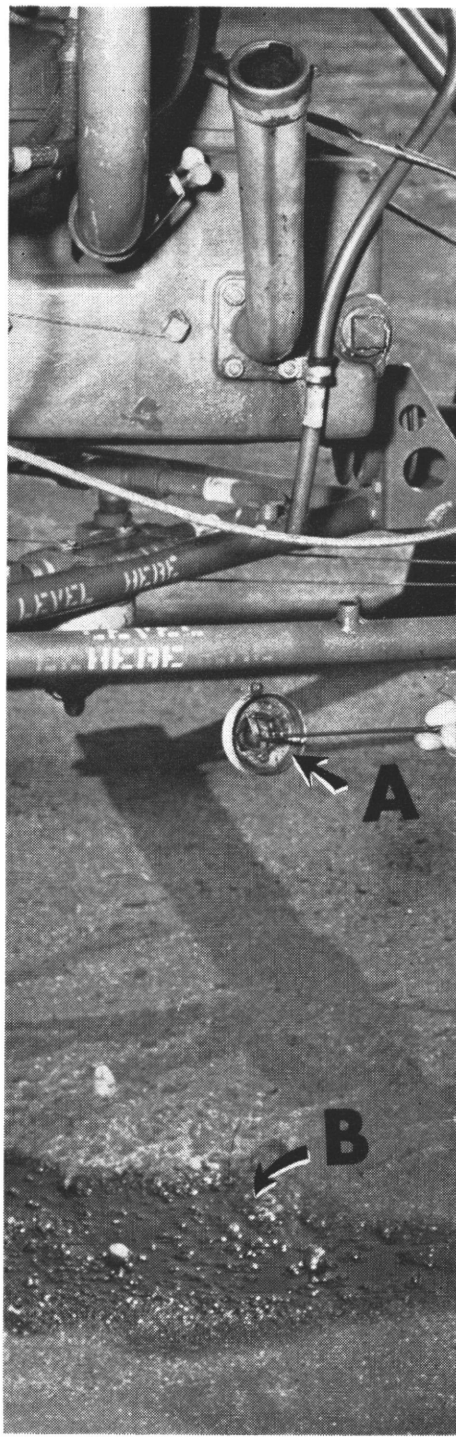
—Contributed by the Department of Maintenance, USAAVNS.

IF UNITED STATES troops are to meet any emergency that arises; if units in training, reserve, or occupation are to be ready for action if and when required; if troops in action are to be successful in accomplishment of assigned missions, commanders must exact effective preventive maintenance from their men.

For the first time in its history the United States faces a long period in which large armed forces must be maintained in a constant state of combat readiness. There has already been a substantial inflation. Both this inflation and the increasing complexity and quantities of equipment are reflected in the Army annual dollar requirement. Military expenses now take well over one-half of every tax dollar. What do these facts mean to military personnel, especially to commanders and their staffs? They mean that there can no longer be the same careless attitude towards equipment which American soldiers previously have found so easy to fall into. It means that much of the burden of proving international Communism wrong in its prophecy of economic disaster for this country will fall on the Armed Forces of the United States. Every dollar must be effectively used. Equipment must be conserved in every stage of training and operations.

To conserve equipment does not preclude its use. Fair wear and tear are necessary in developing trained men and units. Fair wear and tear, yes; but most certainly not waste. Part of every training program must be devoted to preventive maintenance training. This training must be given and the results applied in all phases of operations, or a major war might well be lost without its ever being fought. Preventive maintenance is the care and servicing, by using personnel, of equipment to maintain it in proper operating condition. This is done by providing for habitual and systematic inspection, the detection and correction of incipient failures before they occur or before they develop into major defects.

The preventive maintenance program of military equipment is a command responsibility emanating from the highest and continuing through the lowest echelon of command. All commanders are charged with continuously ensuring that all elements of their commands are capable of performing an assigned task at any time. In this way alone can the difficult problem of preventive maintenance be solved. Commanders today bear a heavy responsibility. Both men and equipment must be kept in top fighting trim. Never in their military careers have officers faced a task more vital to the future of the country.



"A" shows a cork seal and holding teeth missing from an H-13 oil filler cap. When the engine is operated without cap, oil is forced out as shown at B.

Characteristics of Army Aviation Training Attritions

Arthur C. Poe, Jr., Ph.D., and William V. Apple

AVIATION TRAINING is one of the most expensive Army training courses and has a high attrition rate. The U. S. Army Aviation School is constantly striving to increase the effectiveness of its flight training courses. Improved quality of graduates and reduced costs will follow.

Knowledge of the characteristics of students is one factor which could increase the effectiveness of training. The Standardization Division of the Department of Primary Fixed Wing Training has compiled some interesting figures on students who are eliminated from flight training. These data are based upon approximately 745 students who entered training in Officer Fixed Wing Aviator Course, Classes 60-4 through 61-4, inclusive.

The following facts do not distinguish one individual from another. They merely point out the probability of graduation or elimination of students with specific characteristics.

Because of the intelligence

Dr. Poe is Education Advisor of the U. S. Army Aviation School, Fort Rucker, Ala.

Mr. Apple is a member of the Standardization Division of the Department of Primary Fixed Wing Training, USAAVNS.

Description of Characteristic	Number Entered	Number Eliminated	Percent Eliminated
Amount of Education			
College Degree	490	112	22.8
Some College	130	33	25.3
High School Only	119	27	22.6
Military Component			
Regular Army	286	60	20.9
Reserve	324	77	23.7
National Guard	133	39	29.3
Rank			
2d Lieutenant	469	99	21.1
1st Lieutenant	237	71	29.9
Captain	9	1	11.1
Field Grade	29	5	17.2
Age			
21 Years	20	3	15.0
22 Years	112	18	16.0
23 Years	166	30	18.0
24 Years	108	31	28.7
25 Years	93	25	26.8
26 Years	55	14	25.4
27 Years	43	16	37.2
28 Years	42	14	33.3
29 Years	44	15	34.0
30 Years	23	8	34.7
(There were too few entrants below 21 or over 30 years old to yield significant results.)			
Married	530	112	21.1
2d Lieutenant	306	60	19.6
1st Lieutenant	183	48	26.2
Captain	9	1	11.1
Field Grade	29	5	17.2
Single	215	64	29.7
2d Lieutenant	161	39	24.2
1st Lieutenant	51	23	45.0
(There were no unmarried captains or field grade officers in these classes.)			

factors that are considered in selection of officers, the amount of formal education has very little relationship with flight training attrition. High School graduates do as well as college graduates. Those with some college training had a higher attrition rate, but the difference is not significant. In an unselected group, it is probable that the rate of attrition would be inversely proportional to the amount of education.

Regular Army students did a bit better than Reserve students, but both were significantly better than National Guard students.

A glance at the relation of age of students with attrition reveals that learning to fly before 27 is highly desirable. Entrants in the 21-23 age bracket have the lowest attrition rate. Learning to fly is a very young man's game.

The difference in the attrition rate between second and first lieutenants is significant. Difference in age is one apparent cause, but there may be others. This difference should be considered in making decisions that may delay entry into flight training.

Marriage assists rather than hinders learning military flying.

The causes of the above relationships, with the exception of age, are difficult to determine. One expert interpretation is as good as another, but the facts are shown in the figures.

These facts may be useful to applicants who volunteer for training. Those in the categories with higher probabilities of attrition will have to work very hard to complete training. If they are not willing to put forth extra effort, it might be wise to apply for other training courses. Applicants in categories with the lowest probabilities of attrition can expect an approximate 20 percent elimination. Personnel in this group will have to exert considerable effort to survive.

These facts may also be used by School executives in briefing new students and in counseling students who encounter difficulty in training.

Piece by Piece

IN A NUTSHELL, "Keep 'em flying" is the mission of SETAF'S 17th Transportation Detachment, Army Aircraft Repair.

"To put it more specifically," commanding officer Capt Herbert C. Euler declared, "the mission of the 17th is to provide maintenance support for all SETAF aircraft including the replacement of major components and repair of crashed planes."

The 17th is responsible for thirteen H-34 Choctaws, seven L-23 Seminoles, three H-13 Sioux, and seven U1-A Otters.

Men of the 17th are frequently exposed to danger and hardship when called upon to recover crippled aircraft in rough and almost inaccessible places.

They recently spent 8 days recovering an H-34 from a crevice near the top of an 8,100-foot mountain peak. Working on a 2-foot wide ledge and fighting strong winds, heavy snow and subfreezing temperatures, the school-trained mechanics dismantled and recovered the Choctaw piece by piece.

2d Air Cavalry Troop (Provisional)

ENEMY FORCES have invaded the east coast of a friendly nation, and American military forces have been dispatched to the stricken country in response to an urgent appeal for assistance.

Our units are deploying about 80 miles west of the main body of the enemy. We are operating in a country that is essentially a broad tropical jungle delta which receives the drainage of streams from plateaus and mountains to the north.

The invaders have been regrouping and have not begun a large-scale movement inland. However, reports indicate that enemy guerrilla bands are operating to our front. **The 2d Air Cavalry Troop (Provisional), ACTP, consisting of infantry and armed helicopters, is directed to provide a covering force for the corps and to detect, delay, destroy or capture any guerrilla forces encountered.**

* * *

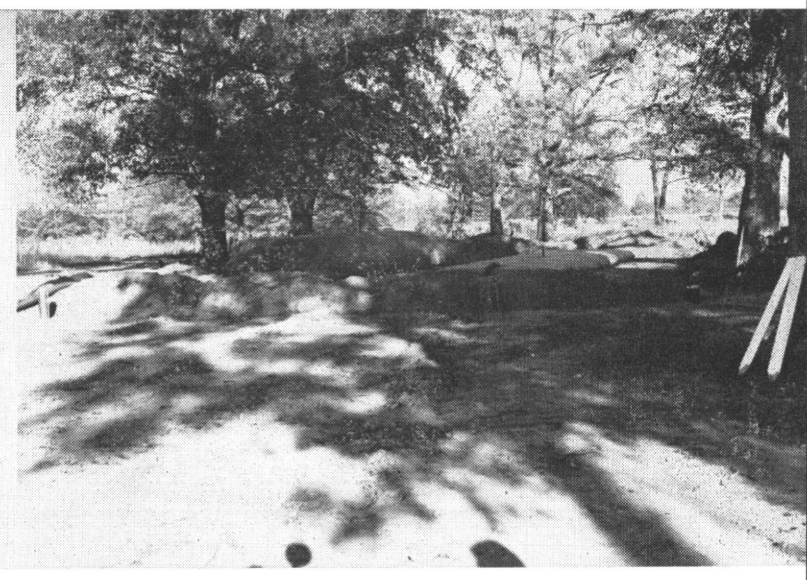
Most ground commanders today agree that Army Aviation can expeditiously move troops, equipment, and supplies. With the development of the air cavalry troop concept, many ground commanders are anxious to know what armed helicopters can do for them. Specifically they want to know more about

- how to employ such a unit as ACT;
- what it can do for them in a fire fight; and
- how much they can depend on ACT to destroy or even slow the enemy.

Many opinions have been expressed on these matters. Some factual information was gathered during the successful Aerial Reconnaissance and Security Troop (ARST) tests conducted in 1960 at Fort Stewart, Ga. Recent Army reorganization plans call for inclusion of Air Cavalry Troops in each divisional Armored Cavalry Squadron.

Answers to such questions were also sought in November at Fort Stewart, where the 2d Air Cavalry Troop (Provisional) was trained under tactical conditions. The training maneuvers were planned to get the ACT into the air, but to keep it in proximity to the ground. Operations were similar to those of the normal armor

ACT training provides information on ammo and POL logistic problems. Left: Loading 4.5″ rockets on H-34. Right: Collapsible fuel storage tanks.



Left: ACT training helps provide helicopter gunnery qualifications criteria and gives invaluable information in the development of helicopter gunnery ranges. Right: In the field maintenance and repair during ACT training.

reconnaissance element.

A project was assigned to the Commanding General, U. S. Army Aviation Center, Fort Rucker, Ala., to form and train the 2d ACT. From this training the Army Aviation Center has assembled valuable information to help

- determine tactical and training concepts;
- develop unit SOPs;
- establish a historical record of problems and solutions in day and night reconnaissance, logistics, organization, tactics, armament, gunnery, training, control, and related areas.

Helicopter gunnery is one of the newest concepts of firepower the Army is developing. A by-product of this training will be the establishment of helicopter gunnery qualification criteria for individual proficiency. Also, ACT experiences should be invaluable in the development of helicopter gunnery ranges. It is felt that this training will reveal procedures for instructing aviators to fly by instinct as they select targets and fire their weapons while either bobbing, hovering, or running at low altitudes.

Information compiled also will be used to develop training criteria for low-level navigation and emergency procedures such as autorotations and straight-ahead and side flares initiated at low altitudes.

Logistically speaking, the training is expected to provide information on ammunition, POL, and ration support; mechanical breakdowns and repair in the field; unit and medical evacuation; liaison, communications, and battlefield control of units of this type.

The operation covered 5 weeks. The first week consisted of individual training such as weapons familiarization, map reading, etc.

The second week involved basic unit training, with aero-squads and aero-sections training separately.

During the third and fourth weeks training was conducted on a platoon level.

The fifth week was devoted to training the full troop and conducting the tactical maneuver.

ACTP represents a giant step forward for Army Aviation and the ground commander. Maneuvers such as Exercise SWIFT STRIKE have proved that Army transport aircraft, properly used, can quickly move entire battle groups in flanking, enveloping, and withdrawal operations (see DIGEST, Nov 61). However, many Army commanders involved in SWIFT STRIKE are still not satisfied that the complete capabilities of Army Aviation are being used. While rehashing the operation, they emphasize that the mission could have been accomplished much easier if armed helicopters had been used. They favored an ACTP type unit within their commands to put teeth in Army Aviation.

On evaluation of the after action reports on this training, a report will be published which will discuss questions posed in this article.

— The Editor

LIVE in the Envelope

Major Joseph A. Gappa, Jr., Inf

". . . AND AS I began to demonstrate spin recovery to the student, I heard a breaking, tearing noise to my rear, and glanced back in time to see the left elevator leaving the aircraft with a simultaneous loss of all control. We then proceeded to . . ."

Could this be you, an instructor at the Aviation School, explaining the seemingly inexplicable cause of structural failure of your aircraft? The maneuver was one you had gone through countless times. It was well executed, and you had taught dozens of student aviators the very same sequence. What went wrong?

A frequently misunderstood, not understood, or ignored diagram appearing in all flight handbooks is the key to the vast majority of structural limitations and failures — the flight envelope, or more commonly, the V-n diagram.

"Misunderstood is possible," one may allow, "but ignored, never! I've taken her up to the **red line** many times, and maybe a hair over, nothing serious. But I've **always** believed in staying within the envelope."

Could this attitude provide a clue to the most probable cause of our hypothetical situation of a structural failure? Let's construct an envelope of safe operating limits, call it a "V-n Diagram," and examine several of the most insidious aspects of flight operation to see if some relationship may exist.

A typical V-n diagram (shaded area) is shown in figure 1.

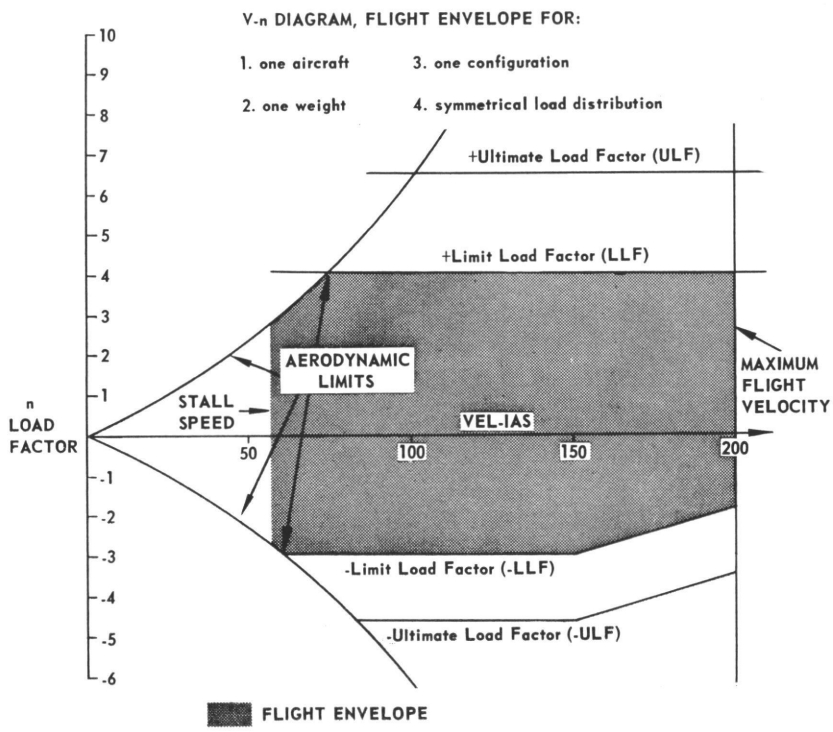
Any fixed wing aircraft producing lift does so in accordance with the basic lift equation:

$L = C_L qS$ where $q = 1/2\rho V^2$

L = lift in lbs
V = TAS in ft/sec
ρ = air density in slugs/ft^3
C_L = lift coefficient
S = area of wing in sq ft

It is known that when the vertical component of lift for any given condition of C_L and velocity is greater than weight (W) the aircraft will climb. If less than W, the aircraft will descend. And if the vertical component of L equals W, level flight is achieved. In level flight, at stall speed, V_s, vertical lift is equal to the weight at C_L at its maximum, or:

Figure 1



Maj Gappa is Chief, Engineering Section, Analysis and Research Division, USABAAR. This article was written while attending the University of Southern California Safety Course.

(1) $L = W = C_{L_{max}} \; 1/2\rho V_s^2 S$

where $C_{L_{max}}$ is the maximum coefficient of lift. This is the lift the aircraft must produce to sustain itself in level flight. In any other flight condition, $C_{L_{max}}$:

(2) $L_{max} = C_{L_{max}} \; 1/2\rho V^2 S$

where L_{max} is the maximum lift capable of being produced. Dividing equation 2 by equation 1, we can express the lift developed under any flight condition of maximum C_L as compared to the flight condition in which lift is equal to weight at the stall speed of the aircraft as follows:

$$\frac{L_{max} = C_{L_{max}} \; 1/2\rho V^2 S}{L = W = C_{L_{max}} \; 1/2\rho V_s^2 S}$$

By cancelling constant terms, $\frac{L_{max}}{W} = \left(\frac{V}{V_s}\right)^2$ and by the definition that $\frac{L_{max}}{W} = n_{max}$ we arrive at (3) $n_{max} = \left(\frac{V}{V_s}\right)^2$

(NOTE: n_{max} is termed G_{max} for a flight load; n_{max} is a more general notation applying to any load.)

If we plot +n or −n against $\left(\frac{V}{V_s}\right)^2$ our aerodynamic limitations are established and appear as shown in figure 1.

The parabolic lines, beyond V_s of the aircraft, define an area in which flight is aerodynamically possible. For any condition **outside** the curves, insufficient lift is being developed at the corresponding airspeed and $C_{L_{max}}$ to prevent the aircraft from stalling. The region labeled SAFE FLIGHT has limitations which will become apparent as we continue with the construction of our envelope.

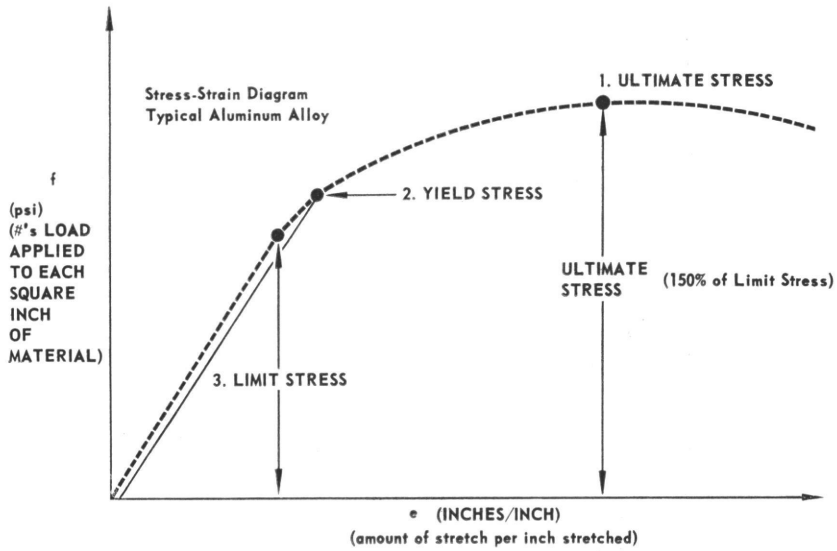
Contrary to the beliefs of persons unfamiliar with flight limitations, an aircraft will **not** fly **safely** as fast as it can be made to travel through the air. The materials and construction of any airplane impose a maximum velocity limitation. Suppose, at full power and sufficient altitude, we one day pushed an aircraft into a dive beyond the **red line** velocity. Several disastrous possibilities present themselves, apart from g forces resulting from the pull-out. These are: critical gust, destructive flutter, aileron reversal, wing or surface divergence, critical compressibility effects (such as stability and control problems), and buffet. Discussions of exceeding **red line** velocity will be carried no further in this article. Interested readers are referred to any good text on stability and control or flutter and vibration problems.

The third and last limitation which must be considered to complete the envelope is the limitation on +n and −n. If a manufacturer were to build an airplane to certain specifications—among them an ultimate load (the highest total load which could be applied **one time** and still permit the aircraft to return safely, though various visible deformations in the structure would be present)—he would have a beginning point in the basic design. In this hypothetical situation, the designing engineers would probably select either 2024 or 7075 aluminum alloy, both of which have stress-strain diagrams schematically represented in figure 2.

Several selected points of immediate interest in figure 2, without going into background details, are:

- Ultimate stress — maximum stress the material can sustain.
- Limit stress—stress such that 150 percent of this figure will equal ultimate stress.
- Yield stress — stress at which objectionable deformation of the material will begin.

Figure 2



• It is to be noted that at the limit stress no objectionable deformation of the material will result. **It is this point** that establishes limit load conditions for normal operation of the aircraft. This point lies **below** the yield stress point.

Basic information needed for design of the structure is obtained from figure 2. For example, the **limit load** is known once the designer is told what his ultimate load will be. From this, the dimensions of the structure can be determined; and knowing the limit load, a limit $n\left(n_{limit}\right)$ can be found from:

$$\text{Limit Load Factor} = n_{limit} = \frac{\text{limit load}}{\text{weight}}$$

[An ultimate load factor (+or—) and a limit load factor (+or—) can be computed once the designer is given the desired aircraft weight, ultimate (+or—) load, and factor of safety.]

Figure 1 shows n_{limit} plotted. The anticipated negative load for the aircraft and the pilot are considerably reduced, making —n less. Further cuts in the weight of the aircraft are possible by reducing —n capabilities at higher speeds, as shown by the nonconstant —n portions in figure 1.

Discussion of overstressing the aircraft (exceeding limit load conditions) was deferred to permit an examination of all possible violations of the limits set by the V-n diagram. Having completed our construction of an envelope, we can return to the beginning of this article and the structural failure example given there. From the nature of the accident and the statement of the pilot, the most probable cause, in this intentionally simplified investigation, was a violation, in some way, of the plus or minus limit load factor (L.L.F.). To aid in a better understanding of a structural failure incurred in the process of a normal, well executed, authorized maneuver, we turn to information contained in figure 2. If a load were applied to the aircraft structure so that the limit stress (L.L.F.) were not exceeded (as in the case of a normal maneuver) **no** objectionable deformation would result and no failure should ensue.

Suppose, however, that in place of one occurrence, numerous identical maneuvers had taken place—maneuvers within the envelope? It **is** possible that repeated loads will "fatigue" the structure and failure **will** result. This supposition is highly unlikely, however, as replacement of time-life components and proper inspection and maintenance procedures will not permit an occurrence of failure where operations are within the envelope. Suppose, then, that the same number of maneuvers, as above, are performed, but several of them are **beyond** the limit load factor —and the overstresses are not reported? Will time-life figures and periodic replacements remain valid? Obviously not. And this is the region of the insidious aspects alluded to earlier. This condition, coupled with poor maintenance and inspection techniques, **can** create structural failure.

Fatigue of materials occurs when a structure is subjected to repeated tension loads. The number of times an aircraft can withstand loads alternately applied and removed before failure results depends directly on the material and the amount of load with each application. Obviously, a high load can be applied a fewer number of times than a small load before failure will result. Time-life replacement of parts is based on tests conducted with a specific material and specific loadings, plus the number of applications of loadings. Overstressing necessarily will reduce time-life and invalidate time-replacement figures. Thus, the dangers created are apparent. Our example has pointed out one facet of a complex problem. In all cases, however, the problem can be drastically alleviated by abiding with the following principles:

• Good inspection techniques and maintenance procedures.

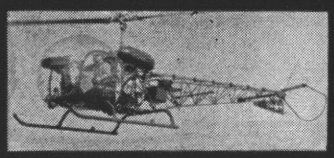
• Operating under the limits established for the aircraft.

In a simplified and methodical manner, we have constructed an envelope of safe operations and explored several examples of violations of our established boundaries.

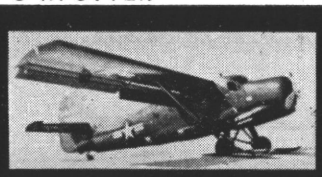
The limits of operations and reasons for limits, the consequences of noncompliance, and the means of altering the boundaries are all fields of lifetime study for aerodynamicists, and structures and design engineers. We can't be expected, therefore, to begin a complete treatment of any one item brought up in this article. It is hoped, however, that the reader has gained more respect for "living in the envelope," and that the various points discussed have stirred his curiosity which will then lead to additional research and understanding.

L-19 BIRD DOG

H-13 SIOUX



U-1A OTTER



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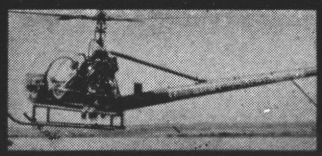


HU-1 IROQUOIS

H-34 CHOCTAW

H-23 RAVEN

H-23D ENGINE FAILED in flight due to fuel starvation. Aircraft completed forced landing with no damage. Fuel level was not checked prior to flight.

L-19A CAUGHT FIRE during engine start. Engine was overprimed, causing carburetor to flood. Airscoop and carburetor filter burned. Incident damage. No injuries.

L-20A FLEW INTO MOUNTAIN during attempt to fly VFR in IFR weather. Pilot and crewchief killed. Aircraft destroyed. Ceiling was approximately 800 feet MSL, with light rain. Aircraft crashed at 850 feet MSL.

AC-1 BRAKES FAILED while aircraft was taxiing. Caribou ran off runway into unimproved area, causing incident damage to nose wheel bearings. Brake malfunction caused by loss of hydraulic fluid from failure of "O" ring seal in nose gear steering assembly.

H-21C CHIP DETECTOR LIGHT came on in flight. Aircraft completed precautionary landing with no damage. Engine analysis revealed failure of master rod bearing.

HU-1A ENGINE FAILED during landing approach. Major damage to tail boom. No injuries. Cause of engine failure undetermined pending investigation. Engine had history of two previous governor failures.

L-19E ENGINE FAILED in flight due to loss of oil. Oil filler cap safety pin was not checked after servicing. Cap apparently came off in flight. Connecting rod in No. 2 cylinder penetrated top of engine crankcase. Aircraft completed forced landing with no further damage.

H-37A LEFT MAIN GEAR collapsed during practice single engine landing. Aircraft was brought to hover and landed with no further damage. Incident damage to gear down lock pin and actuating rod.

HU-1A ENGINE OIL PRESSURE and torque pressure dropped to zero approximately 2 minutes after takeoff. Aircraft completed forced landing with no damage. Suspect internal engine failure. Excessive metal particles found in engine oil filter.

H-21C CRASHED INTO WATER during approach to beach. Aircraft submerged and probably destroyed. Cause undetermined pending investigation. Suspect turbulence may have been factor. Pilot sustained critical injuries — copilot, possible multiple injuries — crewchief, exposure.

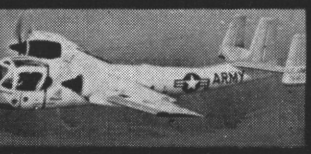
AO-1 SWERVED DURING LANDING roll and blew out right tire. Swerve caused by delay of No. 2 engine propeller reversal. Suspect malfunction of propeller control.

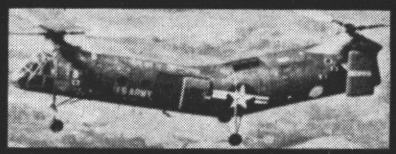
H-13E ENGINE FAILED in flight. Aircraft completed forced landing with no damage. Power settings at time of failure were 3100 rpm and 21" Hg. Engine ran rough prior to failure. Exhaust valve stem broke in No. 5 cylinder. Valve head found embedded in top of cylinder.

H-34C STRUCK TREES during approach to confined area. Incident damage to main rotor blade tip caps.

U-1A TAXIED TOO CLOSE to parked L-23D. Right wing of U-1A passed over fuselage of L-23. Aileron hinge tore omni antenna from top of L-23 cabin.

AO-1 MOHAWK H-21 SHAWNEE L-20 BEAVER





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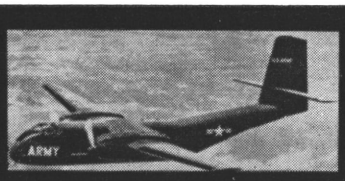

L-23 SEMINOLE H-37 MOJAVE AC-1 CARIBOU H-19 CHICKASAW

H-13H PITCHED UP AND SPUN to right during beach landing. Aircraft struck beach on right skid, bounced over water, spun several more times, and came to rest on right side in 3 feet of water. Aircraft destroyed. No injuries. Suspect tail rotor short shaft failure.

H-13E STRUCK GROUND and rolled on left side during pedal turn to avoid wires. Aircraft had just taken off from field bounded by powerlines. Skids broken off, bubble split, main rotor broken, tail boom severed, tail rotor smashed. No injuries.

H-13E TOOK OFF INADVERTENTLY while mechanic was standing on right skid. Aircraft turned 270° to right and main rotor blades struck ground on right side. Mechanic sustained minor injuries. Aircraft destroyed.

L-20A HIT WIRES during simulated low-level strafing mission. Incident damage to left wing strut, right step brace, and bottom left cowling. No injuries.

H-21C LANDED UPWIND from parked H-13. H-13 rotors were turning slowly after engine had been shut down. Rotor wash from H-21 apparently caused main rotor blade of H-13 to flex down into tail boom. Incident damage to H-13 tail boom. Surface wind, gusting 10-20 knots, was a factor.

L-19A TAXIED INTO HOLE on way to parking area and nosed over. Major damage to landing gear bulkhead, propeller, and engine.

TL-19D TAXIED INTO FIREPLUG. Incident damage to elevator.

H-13G ENGINE LOST POWER in flight and aircraft began extreme vibration. Skid dug into soft earth of steep slope during attempted forced landing and aircraft turned over. Major damage to main rotor blades, engine, transmission, and rotor head. No injuries. Cause of power loss undetermined pending investigation.

H-13H CRASHED AND BURNED during unauthorized flight. Mechanic took aircraft off, flew for approximately 7-10 minutes and landed. He took off again and made tail-low landing attempt which resulted in crash. Mechanic sustained bruises. Aircraft destroyed.

L-20A CRASHED INTO TREES during attempted go-around. Aircraft landed hard on strip, bounced, and directional control was lost. Power was applied for go-around and aircraft crashed into trees. Left wing, elevator, and exhaust stack torn off — sudden engine stoppage — left gear damaged. No injuries.

L-23D NOSE GEAR FAILED TO EXTEND. Emergency procedures were unsuccessful and aircraft landed with nose gear partially extended. Major damage to nose section and propellers. No injuries. Cause of gear malfunction undetermined pending investigation.

HU-1A ENGINE FAILED during maintenance test flight. Aircraft completed forced landing with no damage. Suspect fuel control malfunction.

H-13H PITCHED FORWARD, ROLLED, and came to rest on right side during practice autorotation touchdown. Aircraft destroyed. Instructor pilot sustained minor injuries. Gusty surface wind was a possible factor.

KNOWLEDGE Is the Key TO SUCCESS

Major George Rogers

AS OFFICERS of the United States Army, our career patterns are well established. We know we will be considered for promotion after certain periods of service, and those qualified will ascend the pyramid of success. In the meantime, we know that we must prepare ourselves for the responsibilities that go with success. The most important means available for this preparation is the military education program.

Each branch of service has its time-proved educational program. Regardless of the source of commission — Officers' Candidate School, ROTC, or the Military Academy — each officer is expected to attend the basic officers' course of his particular branch. After he has experienced a few years of "on-the-job training," he becomes eligible to attend his branch advanced course. Still later, we find him competing for those courses of instruction that fall into an atmosphere of graduate-level educational institutions: the Command and General Staff College, the Armed Forces Staff College, and the War Colleges.

But what happens in the early portion of the officer's career, that era when he is preparing himself for specialized service as an artilleryman, an infantryman, an Army Aviator? Does he have adequate instruction available in his specialized field?

Is the overall educational program in the field of Army Aviation adequate? Is it complete? Is it up-to-date? Is there a need for some repetition of material presented in the initial flight training phase of instruction?

Great progress has been made within the past few years broadening the curriculum but the rapid growth of Army Aviation makes it difficult to keep abreast of the subject.

Although not a separate branch, Army Aviation is a highly specialized activity. Since it is so specialized, a definite need exists for a well-rounded educational program for the Army Aviator. We do not have this today. When the student officer completes primary and advanced flight training, he is considered fully qualified and given the rating of Army Aviator. At some time after graduation the aviator can expect to receive instrument training if he was unfortunate enough not to get this additional rating as a part of his initial flight training.

From this point on it is "catch as catch can." You may or may not become dual rated. You may or may not become twin-engine qualified. You may be fortunate enough to get transitioned into transport type helicopters, although the chances are very slim. Further specialized courses are available to a very small percentage of aviators, such as the helicopter instrument course and the instrument examiners course, etc. None of these are programmed for the Army Aviator as he builds aviation experience.

We have considered only courses in which the Army Aviator strives to master the art of physically flying his machine. This is only partial preparation for what is expected of the aviator today, and the greater demands of the future. Flying the machine is very important, but only a single phase of the overall requirement.

Who is going to train the aviation platoon commander, the operations officer, the maintenance officer, the communications officer, the AVIATION SAFETY OFFICER, the unit commander, and the aviation special staff officer?

Sure, we have available courses which will qualify a few selected aviators for any one of these positions. But should not the aviation unit commander and the aviation staff officer have a general working knowledge of duties and functions associated with each of these positions? Sooner or later the senior aviator will be faced with new and more complex responsibilities. He will find himself serving at educational institutions, in high

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Maj Rogers was a student at the University of Southern California Safety Course when this article was written.

level staff positions, in research and development, and a select few will be required to serve some time with industry. In any one of these positions the aviator must make decisions or recommendations that will affect the SAFE and efficient operations of Army Aviation.

After 15 years as a rated aviator, I suddenly found many facets of this highly specialized field that were completely strange to me. I would like to categorize some of these foggy areas.

• In the area of **organization,** the organic aviation companies with differences found in the Infantry, Armored, and Airborne Divisions were new—the organization of Army Aviation within the missile commands, the aerial combat reconnaissance companies, and the organizational structure of the transportation aviation maintenance group that supports the field Army in maintenance and supply.

• In the area of **operations,** I found that set procedures exist for planning an airmobile operation; and for all-weather operations, we have to develop an air traffic control plan. We have only scratched the surface in the employment of the aerial combat reconnaissance companies. With the increase in aircraft density, we must have an airspace utilization plan. To put all of this into operation we must know how to write an aviation annex to the operation order.

• In **aviation safety,** I became acquainted with aircraft accident investigative techniques, aviation psychology, and physiology. I found that I have been totally unaware of numerous conditions that could become flight hazards. In aeronautical engineering, I became acquainted with loads and stresses, stress concentrations, and metal fatigue with its causes. It was somewhat shocking. Other subjects made me wonder how I have survived these many years of active flying.

• So far I have not mentioned **hardware.** New aircraft and associated equipment are coming into the Army inventory which demand more knowledge and training.

I believe the situation in which I found myself is also true for a high percentage of my fellow Army Aviators; therefore, I do not consider this a personal confession of my ignorance as such.

I do not recall the detailed subject matter of my initial flight and ground instruction. The curriculum consisted basically of how to get the L-4 off the ground and back on again. There was hardly enough instruction on weather, theory of flight, and navigation to keep us within the local training area. Sixty hours, to the minute, of flying and very little more of ground school was all that was required for your rating. Advanced training consisted of a few short weeks designed primarily to develop short field techniques. Ground school was devoted almost exclusively to maintenance, as the pilot was the number three mechanic.

Of course this was a wartime expedient and, considering the circumstances, I presume the training was adequate. Many of these "old timers" with this limited formal training are still around. Experience is an excellent teacher, but at times costly in personnel and equipment.

To investigate the question previously proposed and to exploit the requirements for a more thorough curriculum in the field of Army Aviation training, I would like to present a few questions.

As an Army Aviator —

• Do you have an appreciation of the psychological and physiological factors affecting Army Aviation operations? Many physiological factors can and do affect our ability to perform our duties safely and efficiently. Data reported by the Air Force, the Navy, and the Army show that the majority of aircraft accidents are ascribed to unsafe acts or human failures. This should emphasize the significance of the human organism as a cause of aircraft accidents. It is obvious that the human error involved is not the result of careless or willful violation of safe operational procedures, but represents demands made upon the aviator which at times he cannot adequately meet. Higher performance aircraft coming into our inventory will require the aviator's understanding of the more important physiological factors connected with safe operations.

• Do you have a working knowledge of all the items of equipment authorized in an aviation company? The airborne radar? The infrared devices? Air traffic control equipment? Maintenance and care of your equipment is the key to safe and efficient operations.

• Do you know the detailed planning required to support a tactical operation? How to organize the aviation company to best support the division in the attack? the mobile defense? The various considerations necessary to make the operation successful?

Army Aviation is big business; we no longer jump into

our two aircraft and fly into the wild blue yonder! Army Aviation provides a service. We need to understand how the unit we are supporting is organized and operates; otherwise we cannot adequately support or advise the commander in aviation matters.

- Do you understand the principles of logistical planning to the degree that your maintenance and supply support will complement your daily operational requirements? This is a demanding subject and very difficult to put into practice, but one we must all understand to do our jobs effectively.
- Are you acquainted with all the training directives which apply to the aviation unit? Individual training requirements? Army Training Programs?
- Are you acquainted with aviation safety? The continuous increase of aircraft in the Army's inventory and the complexities of the configurations of both present day and future aircraft demands increased emphasis on flying safety. Flight safety is an all-encompassing phrase and is not confined to the safe manipulation of the aircraft controls by the aviator. Flight safety is the product of education, knowledge, understanding, and practice. It requires active participation and support by all concerned, from the mechanic's helper through the commander of the highest echelon or activity having organic or attached Army Aviation.
- Do you know administrative and staff procedures, staff techniques which are so vital to success of any operation?

This brings me back to my original question: Is the curriculum for preparing the Army Aviator for his responsibilities complete? Is it adequate? Considering the overall aspects, the answer must be NO.

This is not criticism of the United States Army Aviation School. I have great admiration for those officers of the staff and faculty who are striving for improvement in all courses related to Army Aviation.

Budget limitations for training have dictated a review of all courses conducted within the Army to terminate those considered "nice to have." For this reason it is practically impossible to establish new courses or increase those currently in being.

I feel that a thorough knowledge of the subjects essential in the conduct of our operations is mandatory of the aviator today.

Primary and advanced flight training prepares the new aviator basically for what will be expected of him upon graduation. This curriculum places the emphasis on flight training but contains some instruction in a few of the subjects heretofore mentioned. Certainly the new aviator would be better qualified with more extensive instruction in aeronautical engineering, aviation physiology, aviation psychology, and aviation safety.

The curriculum for the branch advanced courses does not provide instruction in aviation matters. The Aviation Staff Officers' Course is a step in the right direction but is limited in academic hours available.

One answer to the problem is to initiate an Advanced Aviation Officers' Course. This would incorporate everything taught in the Aviation Staff Officers' Course and include instruction in all facets of Army Aviation. It would require approximately 5 months to present. The course should be mandatory for all aviators after 3 to 5 years of flying experience, but not be substituted for the branch advanced course. I believe the knowledge gained through a course of this type would contribute immeasurably to the profession of Army Aviation.

LOH TEST MODEL CONTRACTS AWARDED

ARMY contracts for LOH test models have been awarded the three aircraft companies recently selected as winners in the Army's design competition (see DIGEST, July 1961).

Bell Helicopter Company, Hiller Aircraft Corporation, and the Hughes Tool Company, Aircraft Division, each will deliver the Army one LOH a month for 5 months beginning in October 1963.

The Army has designated the Bell model, HO-4; the Hiller, HO-5; and the Hughes, HO-6 (see picture).

Problems Connected with

NEW AIR VEHICLES

Major Donald N. Gower, Arty

A LARGE SIGN once rested atop the desk of a medium-grade executive: "Are you helping with the solution or adding to the problem?"

This question deserves a serious answer when applied to Army Aviation of the future, and the Combat Developments Office of the United States Army Aviation School is conducting a study to discover that answer. Whole new families of air vehicles that employ new and varied concepts of aeronautics are being produced by industry. Such names as VTOL, STOL, rotating wing, ducted fan, deflected slipstream, and ground effects machines are becoming more common daily. Some of these new vehicles appear to have military value. Will they ever enter the Army inventory, or are they really more trouble than they are worth? To answer this question we must visualize the type field army that can operate on the nuclear battlefield.

Which branch of the service will have the biggest problem in nuclear land warfare?

Artillery, with longer ranging weapons and communications and adequate ground mobility, does not appear to be in bad shape. It has the capability to stand well back from the FEBA to avoid ground attack, and the capability to operate as small units to avoid inviting nuclear attack. All it lacks is target acquisition means commensurate with the range of its weapons.

Armor also appears to be in good shape. Its vehicles offer some protection from nuclear weapons, and give it the capability to move, disperse, and reassemble rapidly to counterattack in support of infantry elements. Some means of positively fixing the location of the enemy, preferably while disrupting his operations at long range, seems to be the most critical need.

As usual, the front line infantry has the biggest problem. Infantry units must stay small enough to avoid nuclear destruction, yet large enough to fight. To fight a big unit, a small infantry unit must possess high mobility, good men, good weapons, excellent information of the enemy, and all the supporting help from tanks, artillery missiles and guns that it can get. Infantry units can be kept small if their resupply, medical evacuation, mobility, and fire support means can be kept well out of the fighting and well dispersed. Only the combat troops and small arms are needed up forward. The catch in the problem is to have the supply and transport **promptly** responsive to the front line units.

The solution to many of these problems is the air vehicle. These vehicles can give Artillery its targets; they can locate and disrupt the enemy that faces Armor; and they can offer the Infantry the information, mobility, and supply means that it needs to make small units as powerful as big ones. Only by air can support vehicles remain dispersed in the rear and still be promptly available to the front line commander.

What price must be paid for this air support? Does Army Aviation really help the tactical commander, or merely add to

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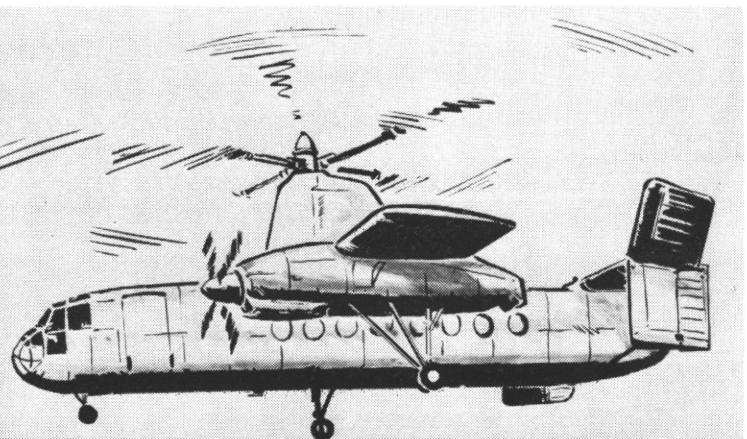
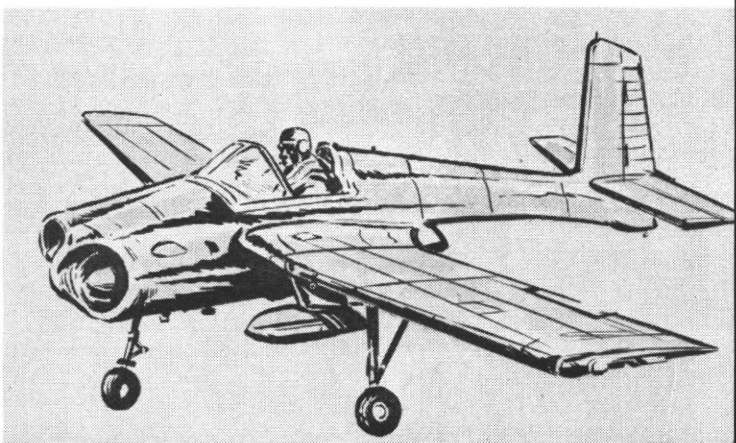
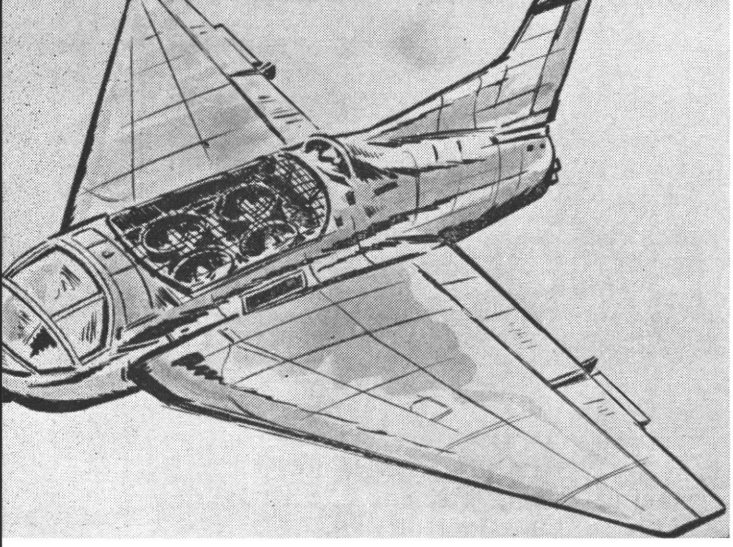
Maj Gower is an aeronautical engineer assigned as a project officer with the Doctrine and Organization Division, Combat Developments Office, USAAVNS.

Compound helicopter



Deflected jet thrust





Lifting engines

Jet ejection lift

his problem? Let's look at the problems we increase or create by the introduction of new air vehicles into the field army.

First of all, air vehicles create their own logistic problems. The greater the number of vehicles, the greater the problem. However, new trends in construction indicate that maintenance problems per individual aircraft may be reduced. This fact coupled with the increase in total number of aircraft means that we can hope to break even in parts resupply. New trends also indicate that the many varied types of aviation fuels now required can be reduced to a single type. Thus, the fuel problem will largely become one of delivering sheer quantity well forward. While a large problem, this one is not insurmountable.

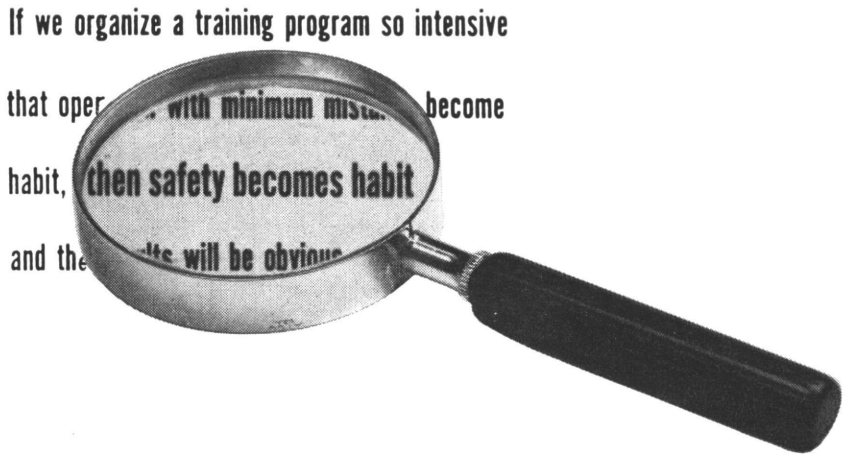
A price must be paid in the number of skilled pilot and maintenance personnel required from the total manpower allotment. This price has been paid to use air vehicles in other wars. A happy medium between aviation personnel spaces and ground combat personnel spaces must answer this problem. Naturally, it will be to everyone's advantage when a new air vehicle can be found which is so simple to operate and maintain that the skill level of the pilot will not have to be high, and the total number of maintenance personnel can be cut to an absolute minimum.

Our new air vehicles must be able to move forward under all but the most extreme weather conditions to reach the rifle companies they support. This may require certain complex radar or infrared devices in each aircraft. Additional devices may be required to allow aircraft to pass over friendly air defense units. Not only will these devices increase maintenance problems, but their radiations will also tend to give the enemy information of air movements. Worse still, if used unwisely, this radiation could offer an enemy missile a target on which to home. Thus, carefully coordinated planning by ground commanders and aviation and air defense staff officers must be a continuing tactical function.

Many engineering problems connected with the new air vehicles have not been completely solved and, consequently, affect the tactical commander and his utilization of the equipment. For example, all aircraft are noisy. Not only does this excessive noise adversely affect passengers and crew but, more important, it aids the enemy in his attempts to locate us. To the engineer, the downwash from a VTOL craft is annoying, but if it does not create an excessive ground pressure or burst into flame, it causes no worry. The tactical commander, however, must find landing sites which will permit extreme winds without disclosing position areas. Since the terrain will not always allow freedom of action, the tactical commander asks the engineer for craft which can land on uneven surfaces and at great range. All such problems receive compromise solutions, and the commander accepts, and lives with, the best the engineer can do.

A summary of the tactical ground commander's needs shows that in nuclear warfare his prime requirements are for information, firepower, and mobility. New aircraft offer at least a partial solution to those problems. New aircraft, however, increase the previously existing problems of logistics, personnel, vulnerability, identification, noise, downwash, landing areas, and ferrying ranges.

The basic problem is simply, "Are the new air vehicles worth the extra effort required to obtain them?" We believe the answer is affirmative and find a precedent in recent history. Who now rides a horse?



Major James R. Davis, Inf

ARMY AVIATORS today should be among the world's best pilots. They must attain high physical and mental standards. Their training is the best that knowledge and equipment can provide. Yet, these fine human specimens and superior aircraft are damaged and destroyed everyday through an easily overlooked fault: negligence.

Negligence plays a major role in the drama of accidents. And where is it so prominent as in our preflight inspections?

How many Army Aviators take the time to perform a detailed preflight inspection?

We must realize that a perfect flight begins with the preflight inspection. Too many of us will take a glance at the fuselage and take off. Why are we so careless? So negligent of our lives?

Let's look at a few examples of what can (and did) happen due to inadequate preflight inspections.

* * *

Late one summer afternoon, Lieutenant Brokit was flying a local training mission in an H-13 when he encountered a local thunderstorm. He immediately landed at the nearest accessible airfield, which was approximately 20 miles from his home field. He waited until nearly dark for the storm to pass; but instead a squall line developed, making it impossible to return to his home field.

After notifying his operations of the situation, arrangements were made to leave the chopper overnight with plans for him to fly it back the following day.

Early the next morning, the flight operations officer received a request for a chopper recon mission with a 0700 takeoff. The only chopper in commission was the one left on the civilian field by Lieutenant Brokit. At 0600 he dispatched Lieutenant Getit and Sergeant Tool over to fly it to the home field.

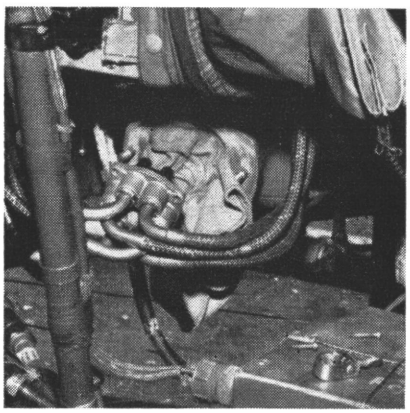
Upon their arrival, a detailed preflight inspection was performed. During the engine runup, the right magneto cut out completely. They soon discovered that the points in the mag had burned up, and it had to be removed and taken back to the shop for repair. To prevent dirt and dust from being blown into the accessory section, a rag was placed in the hole left by removal of the magneto.

Making the proper entries in the DD Form 2391-2 (Aircraft Maintenance Records) which grounded the helicopter, the two men departed for the maintenance shop.

About 10 minutes later Lieutenant Brokit arrived to pick up the helicopter. He had not been notified of the early morning mission and was unaware of any change in plans; therefore his orders were still in effect.

Doing nothing more than untie the rotor blades, he entered the cockpit and immediately started the engine. After

Rag time jazz



Maj Davis is a Senior Army Aviator with over 4,000 hours flight time. He was a student at the University of Southern California Safety Course when this article was written.

warming it up a few minutes he proceeded to check the mags. What happened next takes little imagination. But by the time the engine was stopped, the rag placed in the hole from which the magneto had been removed was ground up into the accessory section.

Loading this chopper and hauling it back to the maintenance shop entailed several hours of back-breaking labor, to say nothing of the many hours spent in getting it back into commission.

All of this trouble could have been prevented if only a few minutes had been spent on a preflight inspection.

Who was at fault? It's easy to see who goofed. The pilot for neglecting his preflight and the operations officer for not notifying Lieutenant Brokit of the change in plans. Nevertheless, it was a costly mistake.

* * *

Aircraft inspections are not the only ones that are neglected; personal and special equipment inspections are neglected, too. When you forget both, you are really living dangerously.

" . . . he noticed a red (condemned) tag hanging from the back strap."

The operations officer had just completed his briefing and everyone was leaving for the flight line when Lieutenant Nochek was called to the telephone. After completing a lengthy conversation with his girl friend, he rushed into the parachute room, gathered up the first parachute he saw, strapped it on and off he went.

Two hours later he returned from his flight and entered the parachute room to return his chute. As he dropped it on a table, he noticed a red (condemned) tag hanging from the back strap. On examination he found that the chute had been folded and wired together. This shook him up considerably. Had he needed to bail out of his aircraft that night, he would have been just as well off without his chute.

Here is an example of two dangerous mistakes: the pilot's failure to inspect his chute before flight and the failure of the equipment personnel to properly stow the condemned chute.

This is not the end of the story: only two months later the negligence of Lieutenant Nochek resulted in the total loss of an L-19.

Upon arrival at Podunk airport on a night cross-country the lieutenant made arrangements for fuel and oil and departed for the terminal restaurant.

After a quick meal he returned to the aircraft, signed the ticket for services, and immediately departed for points south.

Approximately 50 minutes later, there was a sudden drop in oil pressure, and less than 10 minutes later the engine stopped.

A bailout was inevitable. The first thing that entered Lieutenant Nochek's mind was the parachute incident two months before, because once again he had failed to check his chute.

A bailout was made and Lieutenant Nochek's chute opened, but he lived several horrible seconds waiting for it to do so.

This last incident finally made a believer out of him, but if he had only made a pretakeoff check, this aircraft would probably be flying today. The total flying time on this aircraft was only 40 hours at the time of the crash.

The accident investigation revealed that the engine failed due to oil starvation. One connecting rod was completely separated from the crankshaft. The engine suffered little damage upon impact with the ground. The oil cap was never found.

It was not definitely proved that the oil cap was left off during servicing at Podunk airport, but that was the conclusion of the investigation board and the most probable cause of the accident.

This has been another case of negligence. Why don't we eliminate this word from our aviation program? Too often we use the term "human error" when the word should be "negligence" or "carelessness." Its cost in lives and material is too great to condone in Army Aviation today.

If we organize a training program so intensive that operation with minimum mistakes becomes habit, then safety becomes habit and the results will be obvious.

Captain Gene Rasmussen

ARE YOU AS CAREFUL to conserve your hearing as your vision? If we understand the problem and answer honestly, the answer is probably "No." One of the main reasons is that we can experience damaging noise levels without physical discomfort. Even though high noise levels may cause a feeling of discomfort at first, we tend to adjust to them. This adjustment may relieve the discomfort, but the damage to our hearing continues as long as the noise persists.

A hearing loss cannot be treated and restored once a noise induced loss has been acquired. However, noise induced hearing loss can be prevented for the majority of persons exposed to noise.

Working under exposure to high noise levels is unavoidable in fulfilling our mission as pilots. Therefore, each of us should take all practical precautions to avoid the harmful effects of noise. A number of protective measures are available and they become all the more important as the size of our aircraft and powerplants increase.

The aviator should take positive action to protect his ears whenever: (1) the noise level is high enough to make communicating by speech difficult, or (2) he experiences ringing in the ears after working in the noise, or (3) there is a hearing loss that has the effect of muffling speech and other sounds after exposure to the noise. (This hearing loss is temporary and usually disappears after a few hours.)

Pain is produced in the ear when noise levels are on the order of 130 decibels; however, noise induced hearing loss may be incurred at considerably lower noise levels. Noise levels on the order to 110 decibels experienced over an extended period of time produce sufficient sound pressure to damage hearing ability. To better understand these figures we can relate them to some familiar situations. For example, noise levels of 130 decibels may be experienced near the engine of an L-20 or an H-34 during high rpm and manifold pressure. The noise level in the cargo compartment of an H-34 is in excess of 110 decibels during cruising flight.

Dr. Aram Glorig, M.D., director of the Subcommittee on Noise in Industry, and his associates have prepared the following basic information about hearing loss and noise exposure:

"Although there is still much to be learned about the relationship of hearing loss to noise exposure, we have accumulated enough information through

Capt Rasmussen wrote this article while a student at the University of Southern California Safety Course. He is dual rated and is presently assigned to the 68th Aviation Company, Fort Ord, Calif.

experience and research to enable us to organize and conduct hearing conservation programs. This basic information is, in brief:

1. Many noise exposures can produce a permanent hearing loss that may affect communication by speech.

2. Noise induced hearing loss may be transient, permanent, or a combination of transient and permanent.

3. Permanent noise induced hearing loss is due to destruction of certain inner ear structures which cannot be replaced.

4. The amount of hearing loss produced by a given noise exposure varies from person to person.

5. Noise induced hearing loss first affects man's hearing of sounds higher in frequency than those necessary for communication by speech. Therefore, most early noise induced hearing losses pass unnoticed unless they are detected by suitable hearing tests.

6. Four major factors characterize noise exposure:

a. Over-all noise level.

b. Composition of the noise.

c. Duration and distribution of exposure during a typical work day.

d. Total time of exposure during a work life.

7. Man's hearing ability and noise exposure can be measured reliably by competent, properly qualified personnel.

8. To be effective a hearing conservation program should include:

a. A noise exposure analysis.

b. Provision for control of noise exposure.

c. Accurate measurements of hearing."

Having developed an idea of what can cause a loss of our hearing as Army Aviators, let us take a look at what we can do to prevent it. Foremost of the measures which comes to mind is the use of ear plugs. These are available from many sources and are of many types. The type we use as aviators should come from the flight surgeon and be fitted by him. They should be fitted individually for each ear. If the ear canals are not the same size or shape, plugs of different sizes may be required.

A good seal cannot be obtained without some initial discomfort. Properly fitted ear plugs will not irritate or damage the ear. They will not cause discomfort after a reasonable period of adjustment and are highly effective in reducing noise exposure levels at the inner ear. Ear plugs will not make it more difficult to understand speech or to hear warning signals. The slightest leak past an ear plug renders it useless. Contrary to popular opinion, dry cotton affords **no** protection.

Headsets, or earphones, within crash helmets provide some protection. They are primarily designed to convey voice and radio signals and with the exception of some of the latest types were not designed with ear protection in mind. Proper fitting will facilitate their usefulness.

Maximum protection is obtained by the combined use of ear plugs and headsets. Although the protection they furnish is largely parallel in most frequencies, benefits are derived from each which are not provided by the other alone.

To better understand the effect of noise on our hearing as aviators, we need to have a basic knowledge of testing procedures. The testing equipment provided by the Army is among the finest; however, the environment in which the tests are conducted is often very poor. The office of one Army flight surgeon is located on a busy airfield near the military flight line. Audiometer tests are conducted in a multipurpose room with no soundproofing whatever. The noise of vehicles and aircraft outside the building and that generated by people within the building is such that the test is of little significance unless a case of extreme impairment is tested. The office described above conducts hundreds of flight physicals each year.

Since detrimental hearing losses due to noise exposure occur over a 5 to 10 year period, accurate tests must be made and recorded if damage is to be predicted and avoided. Remember, noise induced hearing loss is permanent. Medical treatment will not help. Prevention is the only therapy. Some few persons are highly susceptible to noise induced hearing loss and accurate periodic testing is the only way to find them. A hearing loss usually begins above the normal speech range. The only sure way of detecting it is by testing.

The exact noise levels which can damage hearing have not been defined. Dr. Aram Glorig, a recognized authority on the subject, made this statement: "Wherever the noise at 600-1200, 1200-2400 and 2400-4800 cycles per second exceeds a pressure level of 85 decibels there is potential risk to hearing." (Normal speech is 500 through 2000 cycles per second.)

Whether pilot or mechanic, protect your ears. If you have a question consult your flight surgeon.

HOLD IT! Again

In the December article "Hold It!" figures 3 and 4 were transposed. For accuracy, simply transpose the two cutlines.—Editor

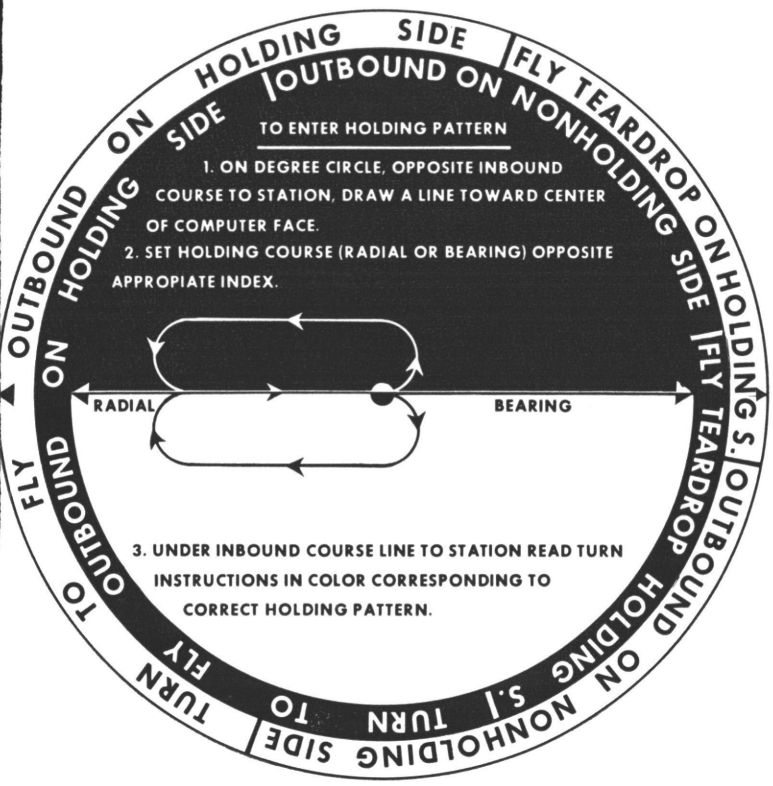
To aid Army Aviators with the new holding pattern procedures in effect, we submit the following aids. We know that many aids are in use and are just as simple, but perhaps these will help you develop a better one or use yours to more advantage.

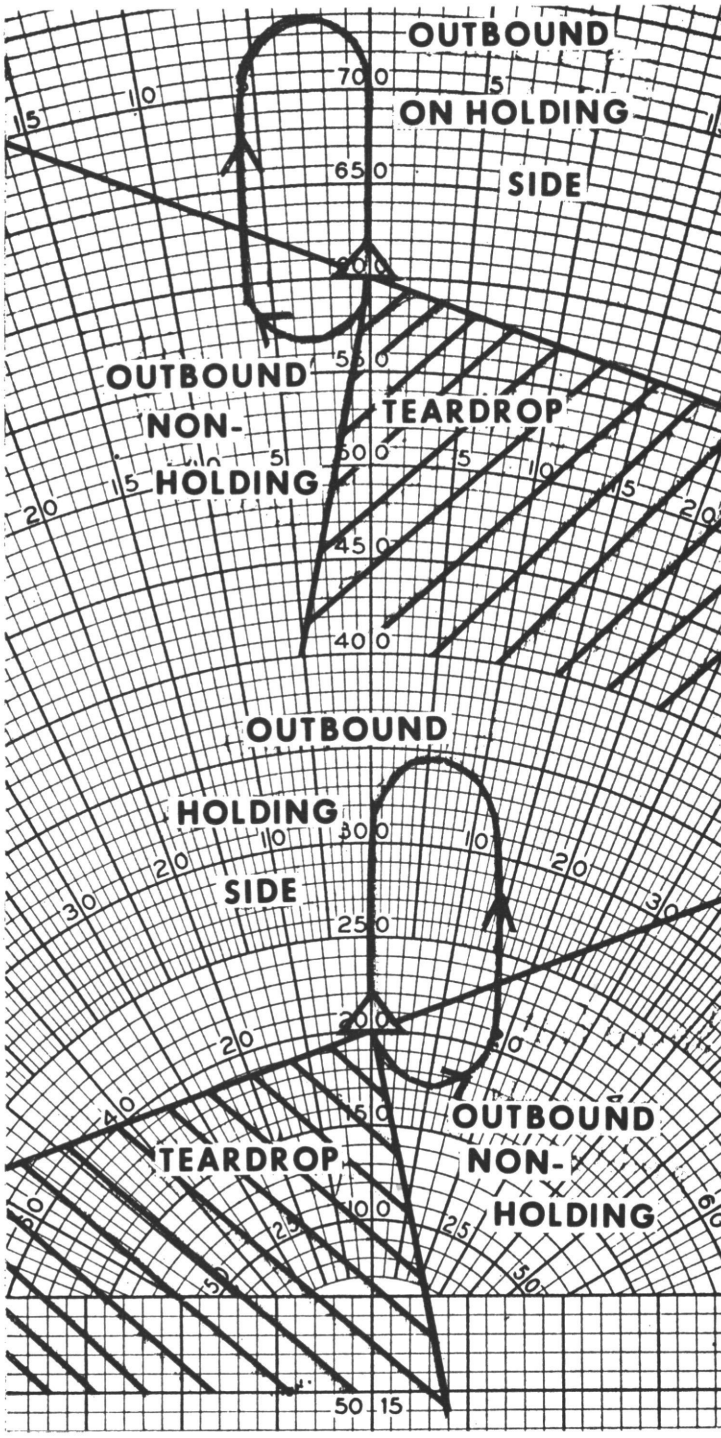
How to use aid right:
Either cut out and attach this drawing to the slide on the E-6B computer or draw three quadrants as shown on the face of the slide. To determine the type of entry in the holding pattern, place true index over the holding radial or track. Next find entering radial or track. This radial or track will show the type of entry to be used.

Example: Standard pattern: True index is 150° holding radial. If you enter on 300° radial, use a teardrop pattern.

Nonstandard pattern: True index is 150° holding radial. If you enter on 300° radial use outbound on nonholding pattern. (Submitted by Lt Lloyd H. Morgan, Dept of Adv F/W, USAAVNS.)

How to use aid below:
Cut out and paste in beneath clear plastic on wind face of your E-6B. Use as instructed on aid.





From The

USAAVNS

Falcon's Nest

DEPT OF MAINT

An understanding of the training of maintenance personnel is important to people who will be involved in the use of the Caribou, AC-1.

Let's look at the program of instruction for the aircraft mechanic. First of all, a small problem arises because a prerequisite for this course is the fixed wing mechanic MOS, 671.1. In other words, this field extracts personnel from other fields. A foundation for aircraft mechanics, however, must be used in training these people. Additionally, he must have a current class II physical and have a score of 100 or over in the aptitude area MM.

The program of instruction requires 142 hours instruction for both the peacetime and mobilization programs. This encompasses the problem of training a mechanic in the specific jobs to be performed, plus the conversion of a single-engine mechanic to a multi-engine mechanic.

A brief listing of the courses and hours, in parentheses, follows: Description of the Aircraft (1), Aircraft Tools (1), Fuel and Induction System (4), Instrument and Related Systems (4), Ground Handling, Servicing and Taxi Procedures (8), Ignition System (5), Preflight Inspection and Engine Runup (4), Aircraft Technical Publications Forms and Records (4), Weight and Balance (4), Oil System (4), Propeller System (4), Hydraulic System (4), Utility System (5), Flight Controls (10), Electrical System (5), Landing Gear and Brake System (5), Loading and Lashing (17), Postflight Inspection (4), Periodic Inspection (24), Flight Procedures (10), Adverse Weather Operations (1). In addition to these courses, the mechanic will have 12 hours for examinations plus a course critique.

Realizing that a more intense learning experience is realized by doing rather than simply by seeing or hearing, 103 hours within this POI are practical exercises, with only 26 lecture or conference type classes. The reasoning behind this is comparatively simple. When a deficiency arises in the aircraft or on the line, it's a good bet that the crewchief has the solution filed away as part of the experience he received on the line while he was in school.

With this training and proper self-motivation, the mechanic produced in this program should be completely capable of keeping a good aircraft in top condition.

CDO

That training bugaboo, insufficient references, should not exist upon implementation of ROAD. FM 1-15, THE AVIATION BATTALION, should be in the hands of troops in the immediate future. This office has prepared and forwarded to USCONARC, Army Training Programs 1-76 for Hq & Hq Co, 1-77 for the Airmobile Co, and 1-78 for the General Support Co.

Also completed and forwarded to USCONARC are the Army Training Tests intended for both company and battalion testing. The numbering system allots 1-75E to the Aviation Battalion, 1-77E to the Airmobile Co, and 1-78E to the General Support Co.

Appropriate chapters for inclusion in FM 1-5 are in preparation. These are intended more for command / general staff recognition than for the aviation unit commander. They will, however, assist the aviation officer in his staff role.

Developmental objectives for future Army Aviation, in operations, in organization, and in equipment, have been completed and approved by USCONARC. When accepted by DA, these will furnish that guidance aviation officers need to ensure that we all work toward the same goal.

CRASH SENSE

PREPARED BY THE UNITED STATES ARMY BOARD FOR AVIATION ACCIDENT RESEARCH

IN THE BOOK

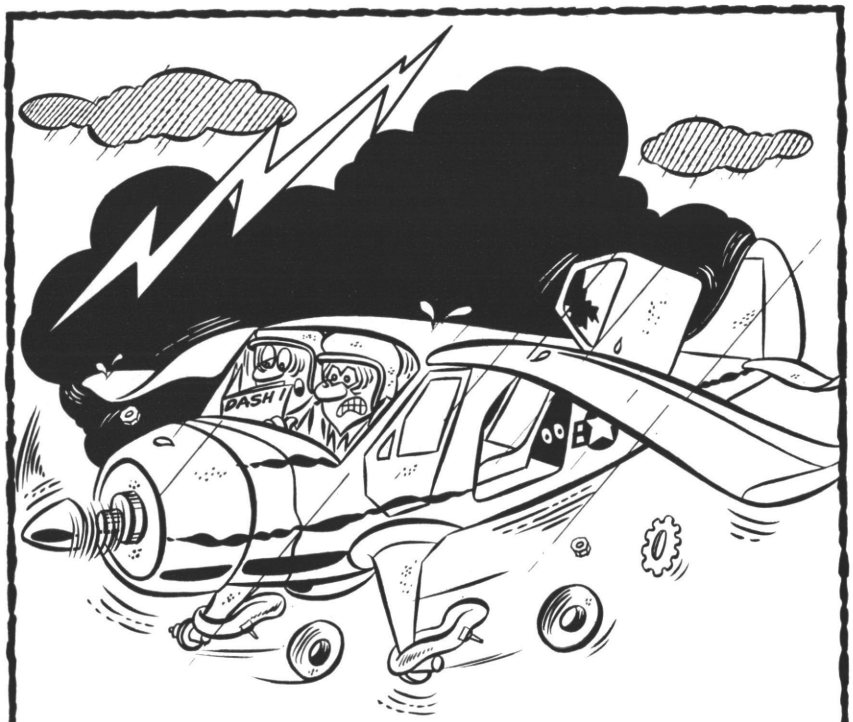
SOME OF YOU, those with affectionate wives and unlimited charge accounts, were lucky enough to find a set of power tools under the Christmas tree last month. Or maybe you found an electric shaver, that new 12 gauge automatic you had been pining for, or perhaps a glass rod and spinning reel. Whatever it was, it's a safe bet you didn't attempt to use it until you'd read every word of the instructions that came with it. Before the first sawdust is swept from your shop, or the first shot is fired, those instructional manuals will have taken on the appearance of the only unabridged copy of **Lady Chatterley's Lover** in the post library. And this is as it should be. After all, power tools and shotguns represent a big investment these days.

Aircraft represent a considerable investment, too, as does your training and experience. Yet, some Army Aviators will risk both by flying without knowing or understanding what's in -1 or -10 manuals.

For a starter, there was the L-20 pilot who attempted to take off **uphill, downwind, on a 2,400-foot runway, using 30 inches of manifold pressure, with no flaps.**

The aircraft staggered off, rose about 20 feet, then slammed into a powerline pole at the end of the field. After striking the pole, and six powerlines, it continued for 350 feet, then crashed at the edge of a dirt road. Fire broke out at impact and the Beaver burned, killing the pilot and three passengers.

Investigation brought out the fact that it was common practice for the aviators in that



"Here it is — 'A safe comfortable penetration speed for the airplane in severe turbulence is 100 knots.' "

particular unit to take off with only 30 inches — "to save the engine."

Couldn't happen to you? Don't be too sure! If you're an L-20 pilot, you've been flying with a manual that contradicts itself. Here's what TM 1L-20-1 says on page 9-4:

"TURBULENCE AND THUNDERSTORMS

"Flights into weather areas where heavy turbulence is forecast or will be encountered should be avoided if possible. **A safe comfortable penetration speed for the airplane in severe turbulence is 100 knots (115 mph) IAS.**

"WARNING—Thunderstorm flying should not be deliberately undertaken in this airplane.

"Power settings and pitch attitude should be established before entering the storm and, if maintained, will result in constant airspeed, regardless of false readings of the airspeed indicator.

"APPROACHING THE STORM

"It is imperative that the airplane is prepared prior to entering a zone of turbulent air. . . ." [Emphasis ours]

Should you attempt thunderstorm flying or not? One instructor pilot tried. The Beaver lost a wing in heavy turbulence and crashed, killing all four aboard.

This section of the -1 manual has read the same for years. Yet, according to the L-20 Project Office of TMC, "This office has no UR records pertaining to information contained in section titled 'TURBULENCE AND THUNDERSTORMS'."

UR the manual? Me?

For some strange reason, the person who wouldn't hesitate to UR an aircraft part has all sorts of reservations about taking the same action for a manual. But who's in a better position to know what should be in manuals than aviators and mechanics?

AR 700-41 spells it out in the second paragraph: "An individual [this means **YOU**] detecting an unsatisfactory condition is responsible for submission of a complete report on that deficiency. Reports will be submitted by military personnel, civilians employed by the Army, or persons in any way connected with the equipment or materiel involved, either under contract or otherwise."

What happens when someone fails to report an unsatisfactory condition? A good example is the Iroquois pilot who got into a high rate of descent during an air show. He noted the condition about 300-400 feet above the ground and continued adding pitch until it was full up. But the high rate of descent continued and the aircraft struck the ground hard in a slight tail-low attitude. The skids spread and the aft end of the fuselage hit. The engine was torn free and the aircraft continued forward, rocking on the nose, then became airborne again. The transmission and rotor system broke loose and the fuselage rolled, coming to rest inverted. The pilot sustained fractures in his back, sacrum, and a rib. The only other occupant, the crewchief, escaped with minor injuries.

This accident happened during the latter part of 1959. Another accident of the same type cropped up a few months later. Fortunately, this one was less severe and there were no injuries. One of the recommendations made by investiga-

"Doesn't EVERYONE know?"

tors of this accident was:

"All commands be again advised of flight characteristics of the HU-1A helicopter."

A reviewing authority's comment on this recommendation was: "There is no requirement to advise commanders of the flight characteristics of the HU-1A helicopter since these characteristics are well known and re-publication of this information would serve no useful purpose."

Several HU-1A accidents since that time have resulted from this same cause factor. As of this writing, **TM 55-1520-207-10 contains no warning about the possibility of a high rate of descent, nor does it explain how to avoid or recover from it.** Section VII, Flight Characteristics, page 7-1, says: "Action and response of the controls during maneuvering flight is normal at all times when the helicopter is operated within the limitations set forth in this handbook."

This is another case where most people know about the condition — it's demonstrated from a safe altitude (3,000 feet) during the transition checkout at the Aviation School —but no one has taken the trouble to include it in the flight characteristics described in the manual.

Need help filling out your UR? See YOU AND THE UR, page 7, U. S. ARMY AVIATION DIGEST, March 1961.

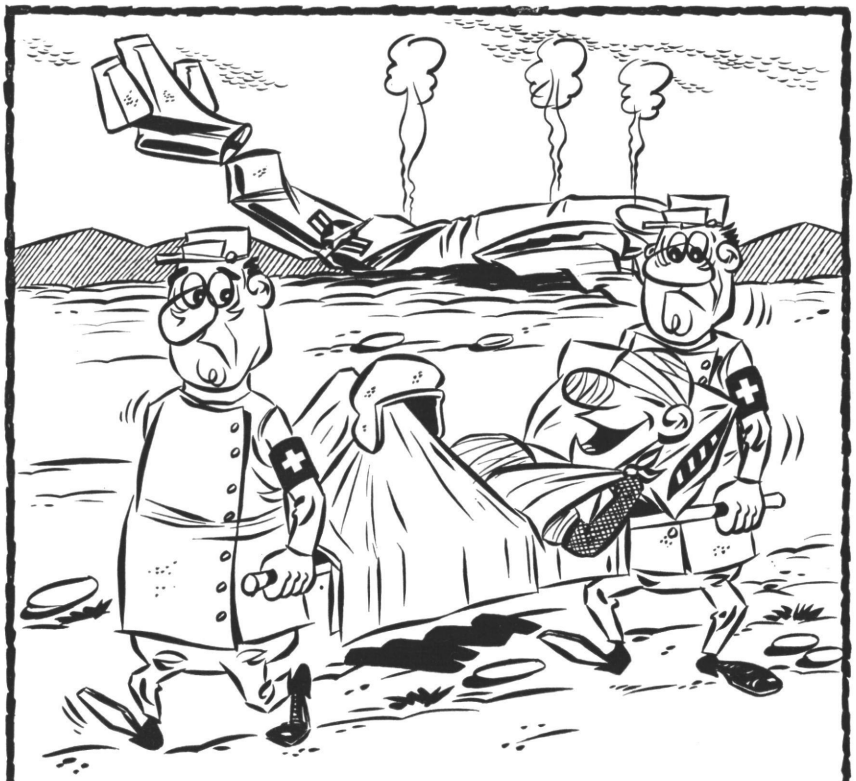
Then there is the aviator who is obviously well versed in everything the -1 has to say, but ignores it in his urgency to arrive somewhere at a particular time. One Senior Army Aviator, with 17 years experience and 4,741 flying hours, was on a return flight to his home unit three days before Christmas in an L-23D. This aviator was known as a conservative pilot. People who knew him well stated that he was always attentive to minor details and had a healthy respect for bad weather. One of his close associates said he had stated that he would never risk himself, his passengers, and aircraft by flying into adverse weather conditions.

After flying for nearly 5 hours, he arrived at the last stop before the final 2-hour plus flight home. His weather briefing for this last leg indicated there would be thunderstorm activity, cumulo-nimbus cloud tops at 28,000 feet, moderate to heavy icing conditions from the ground up, and a cold front affecting the area with ¼-inch hail. A severe weather advisory to this effect had been issued and extended until 0700Z the following day. In the face of all this, the flight was attempted. The aircraft disappeared during the flight and has never been found.

This is what the president of the accident investigation board had to say in his report: "A visit was made to the radar site responsible for the ——— area. It was determined from questioning the radar personnel on duty at the time of the flight that:

"The L-23, when first picked up on the radar screen, was traveling at approximately 200 knots. Its groundspeed fluctuated quite a bit, but averaged out to approximately 170 knots.

"The intensity of the thunderstorms was extreme. The target was lost at times, probably from either entering or going behind thunderstorms. The aircraft made a sharp turn just before it disappeared from the screen. If an aircraft broke up, pieces could be observed if they were large



"NOW I remember the —10 emergency procedures!"

enough, but if it broke up in a thunderstorm, the pieces could not be detected."

And sometimes manuals are ignored by several people in a deadly chain of circumstances. This was the case when an H-34C main rotor blade came loose in flight. The blade struck the fuselage in the vicinity of the upper left pylon and progressive disintegration of the helicopter in the air followed. It crashed and burned, killing the pilot, copilot, crewchief and three passengers.

Investigation revealed the main rotor blades had been stowed. When unfolded, the horn lock assembly of the yellow blade was only partially engaged in the sleeve spindle assembly. The knurled knob was safetied to only 1/16th of an inch engagement of the locking pin in the sleeve spindle assembly locking bracket. According to the book, proper assembly calls for 1¼-inch engagement.

This was a case where the books weren't followed on three successive occasions: when the blades were unfolded, when the work was inspected to remove the red X called for by TB AVN-5, and during the preflight.

Through no fault of their own, some units have received new type aircraft with draft copies of proposed manuals, factory handouts, or no manuals. One Iroquois unit had only manufacturer's draft copies of proposed maintenance manuals.

Following an engine change, MWO (Modification Work Order) 55-1520-207-34/1, dated 25 April 1960, called for alignment of the input drive shaft (P/N 204-040-005-19). According to the MWO, this job must be accomplished using the special alignment tool in the presence of a contractor's technical representative. The special tool and the technical representative were available, but instructions in the draft copies of the proposed manuals, the only manuals available, were vague.

It's not too hard to guess what happened. Scheduled for a transport flight, the HU-1A was flown to the pickup point where five passengers boarded. The flight to destination was uneventful and the aircraft was landed and shut down. On the return flight, a reconnaissance of a training area was made and course set for home. Soon, the crew smelled smoke. The odor was very faint, like a smoldering oily rag, but no smoke could be seen. All engine instruments were in the green and the aircraft appeared to be operating normally. The pilot informed the crewchief that he was going to land and see if he could locate the source of the odor.

A descent was made and a downwind approach established for the helipad. At an altitude of approximately 800 feet MSL, on a heading of 120°, the pilot felt a severe high frequency vibration in all of the controls, followed by a single cracking or popping noise, then a severe vertical vibration. He looked at his instruments and noted that the engine and main rotor rpm were decreasing. Conflicting information made it impossible to determine when the autorotation was actually started.

During the descent, the aircraft made two turns—one to the right and one to the left. It was in an extreme nose-low attitude and airspeed was building rapidly when the pilot attempted to flare. He applied full collective pitch approximately 50-100 feet above the ground, but it had no apparent effect.

The Iroquois struck the

"Runway temperature? --- Density altitude?"

ground in a near-level attitude, while slipping to the right. Vertical impact forces were high, estimated later at more than 15 g. The aircraft rocked forward on its nose, pivoted to the left, bounced off the ground and hit an embankment in a partially inverted attitude. Fuel cells ruptured, causing an immediate fire which consumed a large portion of the transmission, engine section, and right rear cabin section.

Two of the five passengers were killed instantly and another died later. The others, along with the pilot and crewchief, sustained serious injuries. **Three lives, four serious injuries, and a quarter of a million dollar aircraft—all at least partially attributable to inadequate manuals.**

Let's not leave the Mohawk out of this manual discussion. Along with its advantages, this aircraft brings some critical operating requirements—takeoffs, for example—seldom faced by fixed wing Army Aviators in the past. Few fixed wing aviators would bother to compute takeoff distance and flying speed for a 3,000-foot runway that is 10 feet above sea level. But failure to do this resulted in one major AO-1 accident.

The aircraft was flown into an Army airfield to make a demonstration flight. Because it was completely refueled, the pilot determined it was too heavy—about 14,000 pounds—for the demonstration, so he elected to take off early and burn the fuel out of the wing tanks.

He taxied to the end of the runway, lined up and held the brakes while he applied power. When he released the brakes, the aircraft accelerated to approximately 70 knots and he raised the nose. The landing gear came up and the Mohawk settled to the runway. The tail skid hit the runway 935 feet from where the takeoff was started and the aircraft rocked forward on the underside of the fuselage, skidding to within 125 feet of the opposite end of the runway. As it came to rest, fuel spilled from the ruptured right wing tank, but there was no fire. The pilot escaped uninjured.

According to TM 55-1510-204-10, page 2-XI-10, takeoff in zero wind, grossing 14,132 pounds, temperature plus 30°C, at sea level, would require a ground run of 2,150 feet and a speed of 99.6 knots. But the density altitude was 1,700 feet and runway temperature 35° C, so this would be a conservative estimate. The wind, 8 knots, was somewhere between 45° and 90° from the right, which would have resulted in a headwind component of less than 4 knots.

Here was a clear case of trying to fly long before the aircraft was ready—**the belly of the fuselage made contact with the runway 952 feet from the beginning of the takeoff roll.**

The Mohawk gear handle has a latch which prevents the gear from being raised until the oleo struts have extended to within approximately one inch of their full travel. After the accident, the aircraft was placed on jacks and the gear cycled many times to determine whether the latch was operating properly. It was.

This modern world requires operating and maintenance manuals for an endless variety of machines, appliances, and equipment. Here's hoping you'll use that new lathe or shotgun just like the instructions say.

And here's hoping you'll do the same for the aircraft you fly or maintain.

IT COULD HAPPEN TO YOU

MIXED SIGNALS

IT WAS A CLEAR night with unrestricted visibility. We filed an IFR flight plan and took off in an L-23D. I was flying.

Both omnis were tuned to the local TVOR station and the first reporting point was —— intersection. I asked the copilot to tune to a nearby station so I could get an intersect.

I made a left turn, then held my course to intercept the airway at a 30° angle. I held this course for 5-10 minutes, and didn't seem to be getting anywhere, so I asked the copilot to make sure he had correctly tuned the station I had asked for. He turned the volume up and we both identified it as the correct station.

I rotated the course selector all the way around 360° and the station still indicated to the left. We tried a couple of other stations, but they were even worse.

I decided I would chase the needle until I could intercept the airway. We ended up heading due west, which was entirely wrong.

I canceled my IFR clearance and flew back toward the local field. On the way back, we turned both omnis off, then turned them on one at the time and this was how we found it. The No. 1 set which would have been connected to the left dial showed up on the right dial, and vice versa.

When we got on the ground, we had the omnis checked. Sure enough, they had been hooked up in accordance with Murphy's Law—BACKWARDS!

I shudder to think what might have happened if we had been on an actual instrument flight.

CAPTAIN CLU'S CORNER

FLAMEOUT

SEVERAL TIMES lately I've had to leave my jovial companions in their cups and rush off to where some Iroquois chap had autorotated into a pasture. I find this most annoying. So I'm passing on this bit of knowledge in hopes you windy fellows will stop this silly business.

In each of these cases, the embarrassed chap could only tell me that his engine had flamed out. As my forebear so aptly put it, "Elementary." When the engine flames out, check the fuel system.

One of the first places I checked was the quick disconnect coupling in the main fuel line, adjacent to the main fuel strainer on the engine deck. Each time, this coupling appeared secure. But I didn't stop there. I checked further and found there was no fuel in the fuel control or in the fuel line from the main fuel strainer to the fuel control. This seemed strange because there was adequate fuel aboard and the lines into the main fuel strainer were full. Ergo it had to be the quick disconnect coupling!

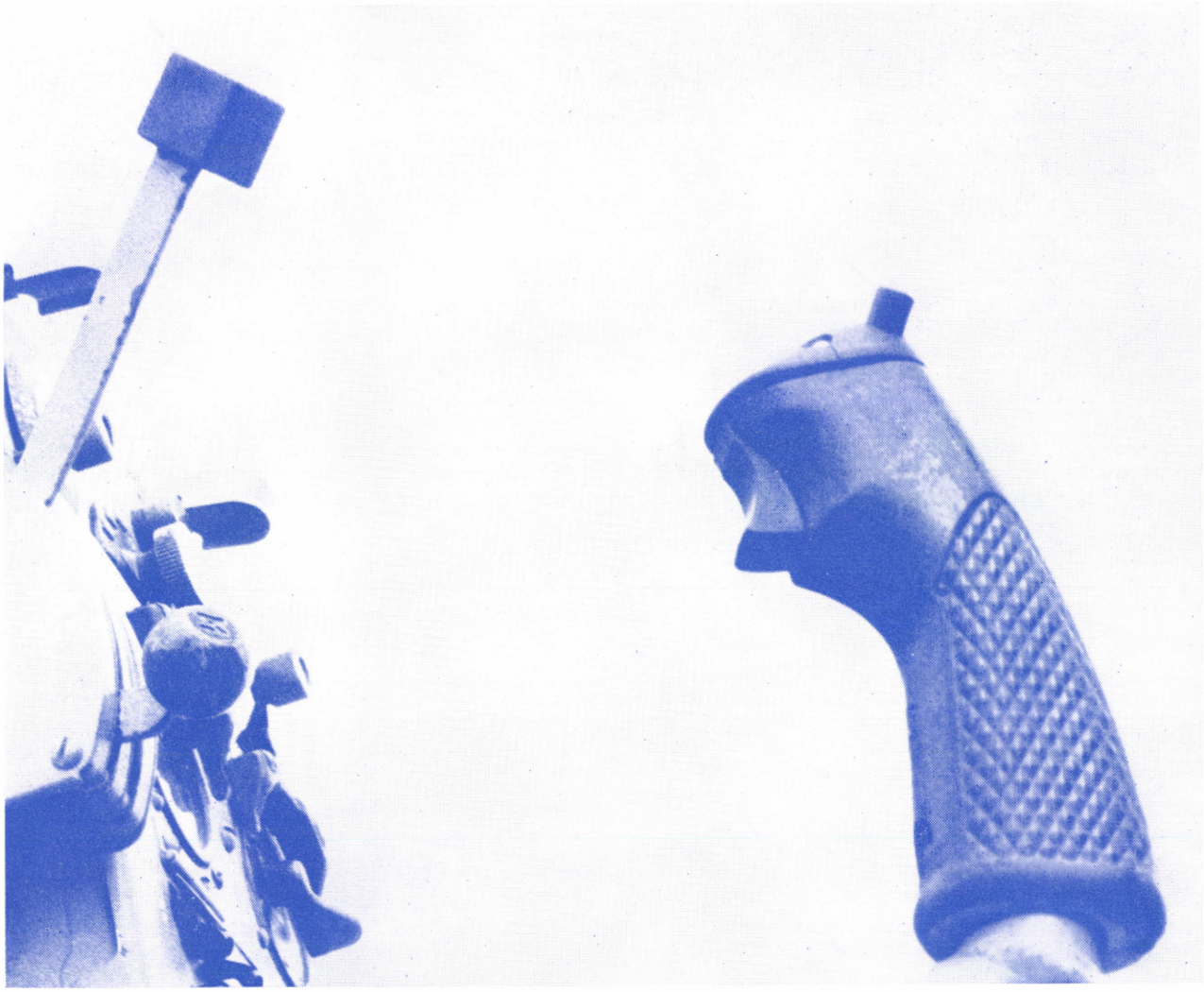
And it jolly well was. Although each coupling appeared secure, it was only partially attached and had backed off just enough to disengage the male and female parts, totally shutting off the fuel.

Now that you know this, won't you please leave me to more enjoyable pursuits? Thanks.

Captain Alonzo Clu, one of the Army's most highly experienced accident investigators, has agreed to share his knowledge from time to time in the DIGEST.—Editor

What's Your Safety Caption?

Send your reply to: Editor, U. S. Army Aviation Digest.



Another Training Aid for New Holding Pattern Procedures

THE Instrument Pilot Instructor School has devised a training aid which some of you may find beneficial in familiarizing yourselves with the new holding pattern entries. The device is a clear plastic overlay on which are drawn a holding pattern and examples of all entries. The overlay is labeled standard on one side and nonstandard on the other side. To use the device, merely place the overlay over the FLIP-Terminal and align the sample holding pattern with the one published, making sure that the proper side is used (standard or nonstandard), then follow the example entry which corresponds to the quadrant in which the aircraft is flying.

Those desiring these overlays may have them produced locally on ozalid film for only a few cents each.

Reprinted from INTERCEPTOR, November 1961. "Holding Style '62" by Capt William F. Schrimsher, IPIS Standardization Board, James Connolly AFB, Texas.

Dir - Plans, Supply + Operations

WE FINALLY made it! After 7 years of active duty with the program, the DIGEST now sports a Senior Aviator's star on its masthead wings.

In the past 7 years the magazine has surveyed many changes—both in the program and in the magazine itself. Growing from a small, pocket-sized magazine with a monthly circulation of 3,200 copies the Digest is now a full-sized magazine of approximately 11,000 circulation.

It all started with the production of a mimeographed newsletter called "The Army Aviator" at Fort Sill, Okla. In a few short months the newsletter became known far and wide in Army Aviation. More and more requests poured in from Stateside commands and overseas. Formal requests for an official Department of the Army periodical with a worldwide distribution were initiated. After the move of the Army Aviation School to Fort Rucker, Ala., approval was granted. In February 1955 the first orange-backed edition appeared. Problems were many, but the magazine continued to grow.

The first 8 x 10 inch magazine came out in 1959, with a resultant increase in articles and illustrations. A new distribution system was also started, using the DA Form 12 series. After the distribution ceiling was lifted, the circulation soared from 6,000 copies to nearly 11,000—and still continues to rise. (If your unit is not receiving sufficient copies, fill out DA Forms 12 and 12-4 and submit them to your local AG publications officer. He'll do the rest.)

Progress continues. As you may have noted with this issue, covers are now in two colors. With the advent of new, more complex aircraft (turbine engines, ejection seats, etc.), and the program's expansion, the need for more room became apparent. Beginning with the February issue the magazine will expand to 48 pages. Color will also be used within the magazine, primarily for functional reasons, to aid in presenting material which is more easily grasped with a touch of color.

All these improvements have one goal: to put in your hands a magazine which stresses aviation safety and aircraft accident prevention and keeps you up-to-date on all aspects of our constantly changing Army Aviation program.